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ANTHRACITE CULM AND SILT

By

James D. Sisler, Thomas Fraser, and Dever C. Ashmead

A Cooperative Study
between the

PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY
Geo. H. Ashley, State Geologist

PENNSYLVANIA WATER AND POWER RESOURCES BOARD
Charles E. Ryder, Chief Engineer

UNITED STATES BUREAU OF MINES
Scott Turner, Director

HARRISBURG, PA.
1928

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LETTER OF TRANSMITTAL

Hon. James F. Woodward,
Secretary, Department of Internal Affairs,
Harrisburg, Pennsylvania.

Sir:

I am transmitting herewith manuscript, maps, and illustrations for a report covering recent detailed studies on the accumulation and use of the small sizes of anthracite.

The anthracite field today is facing a new situation. Competition is becoming very keen, and the industry is seeking all of the facts it can obtain bearing on the present losses and methods of better recovery, and of the uses that can be made of these fine sizes, which in the past have been more or less waste material.

The present report is the result of a triangular coöperation between the United States Bureau of Mines, the Pennsylvania Topographic and Geologic Survey, and the Water and Power Resources Board of the Department of Forests and Waters, whose interest is in securing up to date information regarding conditions as they affect obstruction of streams by waste materials from the anthracite mines.

In the present study new methods of attack have been used, and it is believed that the information obtained will throw much light on problems on which we had all too little information.

It is hoped that the report will be of very much service to the anthracite industry, and to those interested in seeing the streams draining from the anthracite region relieved of the load of waste material now entering them.

Respectfully submitted,

Geo. H. Ashley

January 20, 1928

State Geologist

CONTENTS

ILLUSTRATIONS

FIGURES

PREFACE

The United States Bureau of Mines and the Topographic and Geologic Survey of Pennsylvania have, as one of their policies, been gathering information concerning certain phases of the mineral industry when public interest seems to demand it.

The silt and culm deposits in the anthracite region have been increasing in value each year. A product which has been more than waste—a nuisance, is now of value, and will increase in value as the price of anthracite increases.

The anthracite silt and culm study has as its basis two general problems. The first phase of this report is to answer the questions of briquetting companies, public service corporations, fuel burning companies, foundries, machine shops, cement plants, and river coal operators. Where are the silt and culm deposits to be found? How much of this material is available? What is its quality? How can it be used? All of these questions are answered in this bulletin.

The second phase of the investigation concerns stream pollution and channel silting. This part of the investigation was carried on by the Water and Power Resources Board of Pennsylvania. The purpose of the study was not to lay a basis for future legislation, but to determine accurately just where stream pollution and silting originates, what is being done to stop it, and to determine if any progress has been made since 1915, when the last study was made.

The field work began July 1, 1925, under the direction of James D. Sisler, Associate Geologist, of the Topographic and Geologic Survey of Pennsylvania. He collected information concerning 309 silt and culm accumulations exclusive of the stream deposits in the anthracite regions, or 98 per cent of the total accumulations. This work was done in six months. Mr. Dever C. Ashmead represented the United States Bureau of Mines and the Water and Power Resources Board of Pennsylvania. Mr. Ashmead studied the relation of mining to the production of fine size anthracite, and the stream conditions in the anthracite region.

Mr. Thomas Fraser, a former engineer with the United States Bureau of Mines, and a professor of mining engineering at West Virginia University, began the sampling of 100 or more representative silt and culm deposits May 1, 1926. The field work was completed in November, 1926. The tables in this publication are Mr. Fraser's work. He also wrote the manuscript on sampling procedure, and contributed much to other parts of the report.

The samples were analyzed by Mr. H. M. Cooper at the Pittsburgh Station of the United States Bureau of Mines.

Acknowledgments.

The writers wish to thank and give credit to numerous individuals and companies for their contributions to this report.

The Rheolaveur Corporation laboratories made all the float and sink tests.

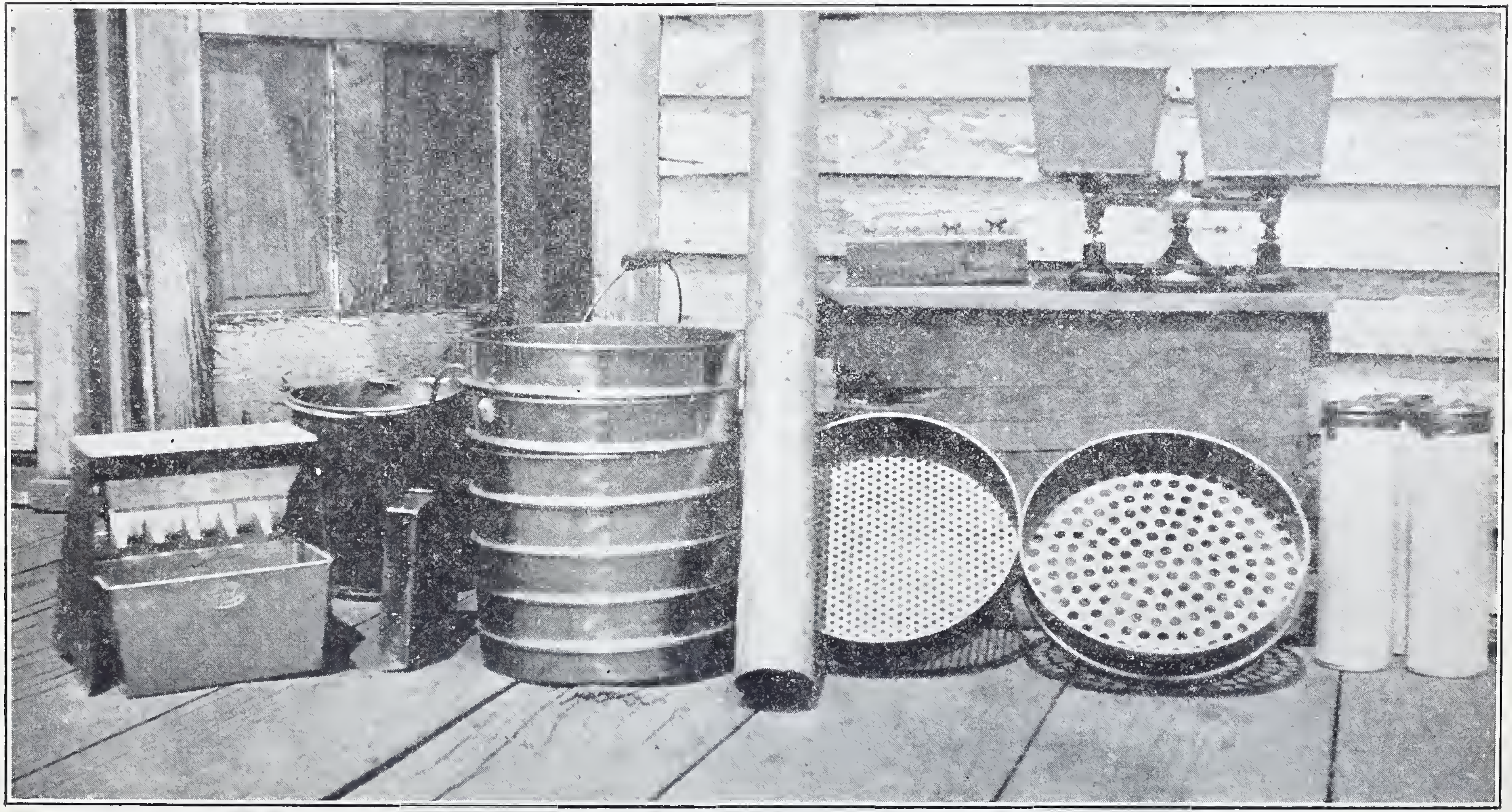
The State Mine Inspectors contributed much information, and many of them acted as Mr. Sisler's guide through the anthracite region.

The coal companies generally were extremely courteous in giving information, time and labor to the authors.

E. A. Holbrook, Dean of the School of Mines and Metallurgy, Pennsylvania State College, J. W. Paul, chief mining engineer, Pittsburgh Station of the United States Bureau of Mines, George H. Ashley, State Geologist, and Charles E. Ryder, chief engineer of the Water and Power Resources Board, made many of the suggestions which formed the basis of the report, and furnished guidance to its completion.

The text was edited by R. W. Stone, Assistant State Geologist, Topographic and Geologic Survey of Pennsylvania.

PLATE I



Equipment used in sampling culm and silt. From left to right, standard Jones riffle sampler, set of 12-inch round hole screens, 3-inch sampling tube, scales, sample cans

ANTHRACITE CULM AND SILT

By James D. Sisler, Thomas Fraser, and Dever C. Ashmead

INTRODUCTION

Pennsylvania has produced 5,500,000,000 tons of anthracite. Active mining started in 1830 and has increased until the annual production ranges from 80,000,000 to 85,000,000 tons. In mining anthracite 10 to 15 per cent of the coal is of very fine size, and can be marketed and used only in prepared form or on specially constructed grates. Nine million to 10,000,000 tons of this fine sized material is produced each year in the anthracite region. In addition to this fine sized material several million tons of rock are brought to the surface and piled on huge rock banks. The disposal of this waste material has become a serious problem in the anthracite region. The level land areas are at a premium because anthracite occurs in basins with steep-pitching slopes and the natural topography coincides with the structure, that is, the basins are flanked on both sides by mountains and streams flow through the valleys.

The valley in which the Northern Anthracite Field occurs is broader than those of the other fields and naturally provides more storage for this waste material. This land is valuable for building purposes and it is difficult to find suitable locations for waste banks.

In order to make room for more waste material much fine sized coal, boiler ashes, and pulverized rock is allowed to go into the streams each year. This silting has resulted in serious damage at numerous localities. Within the last few years many of the banks have been worked over and the good coal recovered from them. This has relieved, of course, the accumulation of silt. Companies also have been taking more interest in the proper means of settling and storing the fine material. At certain localities the stream beds have been dredged and at some localities the material has been entirely removed.

Disposal of Anthracite Culm and Silt

Steep-pitch mining makes it necessary to bring to the surface all material which is mined. The coal which goes to the top of the breaker is mixed with rock and slate. The breaker separates the impurities from the coal, and the rock and slate are discharged on rock banks on the breaker property. The fine sized material, which is usually 60 to 85 per cent combustible, issues from the breaker with the breaker water. Some companies let this material go directly into the streams, but it is common practice to settle the water so that the largest pieces of the material are recovered. This settling is effected in numerous ways. The most prevalent means

is by building up a silting dam or bank. A silt bank is started by boarding up a suitable area and the water runs over this area at a low gradient and deposits most of its burden before it flows over the boards. As the area behind the boards gradually fills up the edges of the bank are raised higher by the addition of more boards and by piling silt against them to hold the weight of the material. This process is repeated until the silt dam has been built up 20 or 30 feet. This manner of settling is very good provided the stream of breaker water is turned into numerous channels upon entering the silt bank. If the water is not spread out fan shape over the bank it runs directly through it, does not deposit any of its material, and takes with it some of the material which has already been deposited on the bank. In order to correctly settle silt in this manner it is necessary to have a man constantly on the location directing the course of the breaker water, building up the sides of the bank, and raising the sluices for the clarified water to escape from the bank. The water which soaks through the bank and comes out at the bottom is practically clear, and if the water is properly settled before it reaches the sluices which are placed in the walls of the bank, it also is practically clear.

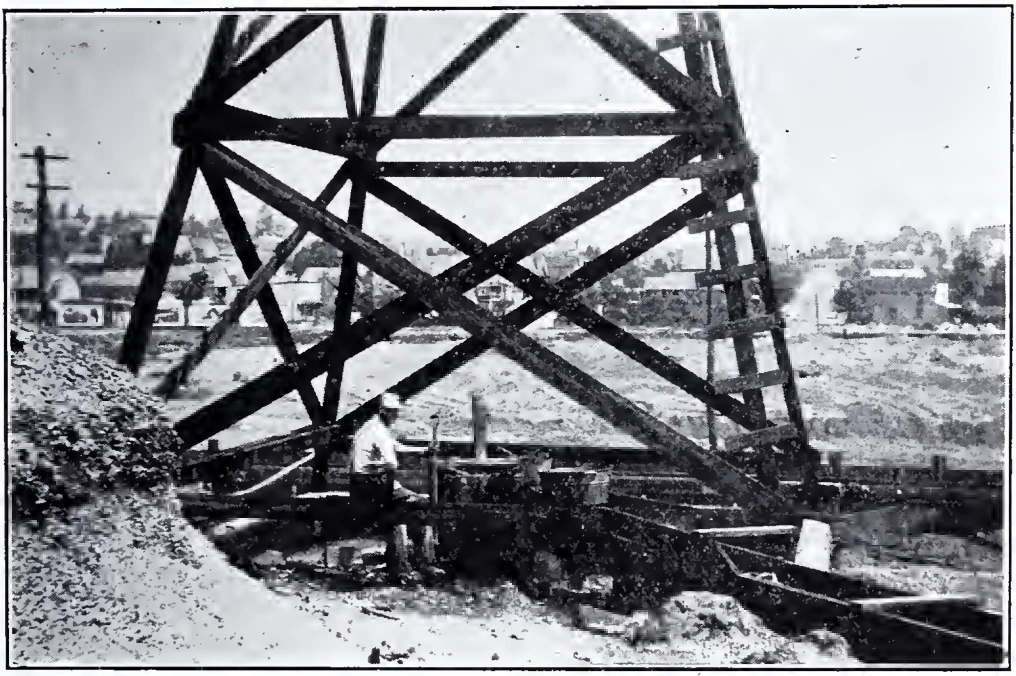
At locations where land is at a premium or the hillsides are steep, breaker water is generally settled in a tank. This tank is usually constructed of concrete of a size large enough to adequately take care of the entire output of water. This tank is usually divided into two or more compartments; the water is run into it and deposits the largest sizes in the first compartment. The sizes become smaller in each succeeding compartment, and if the tank is large enough and is not allowed to fill up, the water is practically clear when it issues from it. The silt which has accumulated in the tank is removed by an automatic scraper line or a suction pump. The great difficulty with this method of settling is that some companies are somewhat neglectful and allow the tanks to fill up with silt and the water runs directly through them without settling the material.

Numerous settling tanks, thickeners, and clarifiers are on the market and are described in the chapter on preparation. These mechanical devices are almost perfect in their action. Breaker water which is heavily ladened with material can be settled within a short time so that it issues as clear water from the tank. The action of these tanks can be regulated so that any percentage of the material can be separated from the water.

The Northern Anthracite Field is thickly populated and mining is carried on beneath valuable surface properties. It is necessary to provide proper support for these properties and in order not to leave large tonnages of virgin coal in pillars many companies are using silt for mine filling. When the coal is removed silt is flowed into the opening. It gradually consolidates and forms solid pillars and permits the mining of the solid coal pillar which has been temporarily left for surface support. Thousands of tons of silt have been used for mine filling in the Northern Anthracite Field and some has been used in the other fields. The method of mine flushing varies but little. The silt is usually mixed with water

and pumped or dropped inside the mine through a bore hole or through a pipe in the shaft. It is conveyed to the proper place by pipes, or on steep pitches it is allowed to find its own course. Bulkheads are built of substantial wood to prevent the spread of the material throughout the entire mine. These bulkheads are sufficiently porous to permit the water to drain out of the silt. After standing for a few months the silt is consolidated and it is pos-

PLATE II



Bore hole used for silting mine workings at Stanton Colliery, Lehigh & Wilkes-Barre Coal Co. The silt enters the bore hole through a wooden sluice.

sible to drive gangways through it. The use of silt as mine filling not only prevents subsidence but it holds up the roof inside the mine and makes possible higher percentages of recovery.

Some of the rock which is a by-product of coal mining, is pulverized and sent back into the mines. Boiler ashes are also used for mine flushing. This process has resulted in the removal of large silt banks in the Northern Field and has reduced the surface accumulation of this material.

Definitions

The term culm has evolved in its meaning since the beginning of anthracite mining. In the early days of the industry practically all the coal was prepared dry. The fine-sized material, as well as the sizes which were not marketable at that time, were deposited along with the waste material in huge banks on the breaker property. These banks contain from 50 to 80 per cent coal, and some of them have large percentages of steam sizes in them. These banks have been practically removed with the exception of those owned by large companies in the Southern Field. These banks are known as culm banks. A culm bank is defined as an accumulation of rock, bone, and coal from an old dry breaker.

A rock bank is the refuse from a modern wet breaker. These rock banks contain from 1 to 5 per cent of marketable coal, and are of no value except for mine filling.

A silt bank is an accumulation of fine-size coal, bone, and slate which is settled out of breaker water. This material is known also as sludge, fines, slush, and mud.

Breaker water is the water which is used in the breaker jigs during the preparation of coal.

Drip or waste water is the water which drips from the storage bins and from railroad cars after the coal has been loaded.

Mine water is the water which is drained or pumped from a mine or drift. This water contains a small percentage of solids.

Mud, slime or sludge is refuse material from a breaker which passes through a 200 mesh screen.

Size and Number of Silt and Culm Banks

During war time and strike periods since 1915 a large number of the old clum banks were worked over. Some of these banks have been sold to public service corporations as reserves of boiler fuel, others are being held in reserve by large companies for emergency fuel. These banks range in size from very small accumulations to 5,000,000 tons of material. Most of the banks of any value contain a few hundred thousand tons of material. These banks vary greatly in quality and in size. Some of the older banks contain 80 per cent coal. The newer banks contain from 20 to 60 per cent marketable coal.

Silt banks also vary much in size and quality. These banks range from a few thousand to 10,000,000 tons in size. The silt usually contains from 15 to 50 per cent ash. Some of the banks have been mixed with boiler ashes and are of little value. The banks which have been very seriously polluted with ashes have not been estimated.

Old culm banks and new rock banks have been used for the settling of breaker water. This has resulted in a mixture of culm and silt or rock and silt. If the mixture is culm and silt the bank is of great value, but if the mixture is rock and silt the value of the material is problematical.

CONCLUSIONS

General Conclusions

The large population and great wealth of the anthracite region is directly attributable to the occurrence and mining of anthracite. Before 1830 the valleys in the anthracite region were forested and were the sites of numerous small clearings where farmers were beginning to cultivate the fields. The discovery and subsequent development of anthracite has changed the appearance of the anthracite district. It is no longer a region of forests and fertile fields. Mine water has polluted most of the streams, the surface is scarred with holes where mine workings have fallen in, and enormous piles of rock, silt, and culm have accumulated. If anthracite were not being mined the valleys would be fertile farm lands, and the mountains between the valleys would be forested.

In viewing the apparent destructiveness of mining one must not forget the great wealth which has come from this industry and the great benefit that is has been to the development of all of Pennsylvania's resources. The anthracite industry drew to Pennsylvania many of its Scotch, Welsh, and English pioneers. It has provided fuel for thousands of homes for 100 years; it has brought prosperity to thousands of people. The havoc which anthracite mining has done to the streams and forests in the anthracite field is nothing in comparison with the great influence it has had upon the development of Pennsylvania.

The anthracite industry is the basic industry of the region. Without it the area would be depopulated. The pollution of streams by mine water, the silting of channels by waste material, and the destruction of vegetation by mining is a necessary evil of this industry.

It does not follow, however, that an effort should not be made to reduce these objectionable features in the mining of coal to the lowest practical limit, without curtailing production or materially affecting the cost to the consumer. This investigation seems to indicate that there is opportunity for marked improvement in the disposal of waste material from the mines and breakers; in fact, improvement has already occurred because of the recovery in the breakers of the finer sizes and the use of silt for mine filling, and there is every reason to believe that if the coal operators should unite and co-operate in a general study of the problem, methods could be devised or present methods improved and put in more common use, with increased efficiency in operation, which would greatly reduce the quantity of silt at present being discharged into the streams in the Anthracite Region.

Specific Conclusions

The sampling work upon which the following estimates of silt production and fine coal losses are based, extended from May 1 to December 1, 1926, a period of seven months. Banks at 47 collieries were sampled. The aggregate production of these collieries in 1925 was 10,664,000 tons. This was approximately 17 per cent of the total production of anthracite. Twenty-two of these collieries are in the Northern Field; eight are in the Eastern Middle Field; eight in the Western Middle Field, and nine are in the Southern Field. Extensive accumulations of culm and silt in the valley of Beaver Creek and in the Mahanoy Valley also were sampled.

Although sampling work was done at only a comparatively small proportion of all the operating collieries, the collieries selected for study were so distributed as to represent the entire field geographically. They were selected after a careful survey of the field during the previous season, so as to include operations using all the variations of mining, preparation, and silt handling methods.

This investigation was extensive enough to obtain reliable data as to the quality of coal in silt accumulations throughout the field and to estimate the total annual production of silt. Although there is great variation in both the quality and quantity of fines in the coal which is produced in the anthracite fields, the variations are largely regional and were considered by separately treating the numerous distinct areas in which mining conditions are similar.

The methods of storing and disposing of silt and slimes and handling of waste water vary so greatly that it is much more difficult to arrive at a general estimate of losses of fine coal. Discharge of fine coal from preparation plants which were visited in this survey ranged from none to 15 per cent of the total tonnage of prepared coal. Averages of such diverse size are of little value for specific application in any one operation. However, some general conclusions are obvious from the results of the study. Measurements were made at operations representing all methods and all degrees of effectiveness in silt storing practice to be found in the anthracite field.

Quality of coal in silt. The quality of coal in silt banks in the anthracite field was found to range widely both as to purity and percentage of commercial sizes. There are general regional differences in the character of the coal beds and the mining conditions that affect the character of the silt which is produced in the various mining districts. There are still greater local variations in the silt deposits and current silt which is produced at various collieries, due mainly to (1) age of banks, (2) methods of handling silt, (3) method of cleaning coal, and (4) effectiveness of sizing screens.

Percentage of oversize. The common practice in screening in modern plants is to make the smallest commercial size over screens with 3/32-inch round holes. At a few plants No. 4 buckwheat (No. 2 barley) is shipped intermittently and at some plants 1/16-inch holes or a combination of 1/16 inch and 3/32-inch holes is used to obtain a certain percentage of undersize coal in the No. 3 buckwheat (No. 1 barley). Whatever the local screening practice may be, it generally aims to discharge from the breaker no coal larger than 3/32 inch, which is the lower standard size limit of No. 3 buckwheat coal. Coal found in the silt discharge or in the silt banks that will not pass through a 3/32-inch testing screen is, therefore, regarded as a loss of marketable size coal.

The percentage of oversize in new banks and current silt being produced at the collieries where samples were taken varied in the Northern Field from 1 to 16 per cent, with many more observations nearer the lower limit than the upper. The normal may be taken as 4 to 6 per cent, and many collieries lose only 1 to 2 per cent of commercial sized coal in the silt. This loss varies greatly all over the anthracite field due primarily to differences in screening practice. There is little difference as a whole among the different mining fields. A high percentage of oversize in the silt is apparently more common in the Southern Field than elsewhere, with the exception of the mines in the Panther Valley, which have reduced this loss to practically nothing. In most plants where auxiliary silt shakers are in use to rescreen the silt just before it goes to the bank, the loss of No. 2 buckwheat is under 2 per cent.

Percentage of slime. The percentage of slime, or material which passes through 200 mesh, in the silt which is produced is subject to considerable regional variation. It increases generally from north to south and from east to west with local variations. This is primarily due to differences in the friability of the coal and the pitch of the coal beds. The percentage of 200 mesh material in samples of silt from fresh mined coal ranged from 13 to 15 per cent at most of the Wyoming Valley collieries to over 30 per cent at others in the South-

ern Field. Screen analyses were made by hand testing with Tyler screens on dry coal, and probably gave results which were consistently 3 to 5 per cent lower than the same samples would give by wet screening.

The percentage of fines in silt banks primarily depends upon the method of handling the silt from the washery to the bank and the effectiveness of settling. Locally, therefore, silt accumulations vary, in the proportion of material through 200 mesh, from 2 per cent up to the total quantity in the original silt produced from mine-run coal or even more if much bank coal has been handled in the preparation plant. The effect of various methods of handling and storing silt in retaining or eliminating slime is discussed more completely under silt handling methods.

Ash content and calorific value. The purity of the fine coal discharged at various collieries in the anthracite field varies, like the size, with local mining conditions and preparation practices. There is a fairly general adherence to certain regional averages. Disregarding exceptional cases, where unfavorable conditions prevail, the raw silt discharged from plants which treat fresh-mined coal in the Wyoming Valley, is 20 to 25 per cent ash. In the Eastern Middle Field it normally is 25 to 30 per cent ash, and in the Western Middle and Southern fields from 30 to 40 per cent, decreasing toward the west. Lykens Valley silt is particularly low in ash. Float-and-sink tests show that throughout the anthracite field it is possible to reduce the ash content of the silt to 10 or 12 per cent by rejection of 15 to 60 per cent of the raw material as refuse. The high ash content of the raw untreated silt in certain fields is accounted for by the excessive quantity of dirt that is intermixed with it in mining and not to an inherently high ash content in the coal.

The calorific value of the coal in silt banks that have stood for some time is a little lower than that of fresh-minded coal of the same ash content. This deterioration varies with the age of the bank and was over 4 per cent in the most extreme case of weathering. The coal in banks which are in use for storing silt and that have been accumulating for 5 to 10 years, has 100 to 200 B. t. u. per pound lower calorific value than fresh-mined coal samples of the same ash content from the same colliery. In banks that have been exposed for 40 years, this difference is as much as 500 B. t. u. per pound.

In normal fresh-mined silt, to which no slate has been added in the preparation plant, the finer sizes increase progressively in ash content with decrease in size so that the dust through 200 mesh, which is of suitable size for burning as powdered coal without grinding, is practically worthless because of high ash content. At most collieries where samples were taken, this product contained approximately 50 per cent ash. The only exception observed was in the extreme western part of the Western Middle Field. There the finest material in the silt samples is cleaner than the coarse sizes.

Volatile matter. Many of the high-ash fine-coal samples have an abnormally high percentage of volatile matter. (See the tables at the end of this volume). This is attributable to the presence of water of hydration in the ash-forming minerals of the sample

and does not represent the percentage of combustible volatile matter. For example, in the Buttonwood silt bank sample, the product through 200 mesh showed 13.7 per cent volatile by the standard method of determining volatile matter. The total water content, determined by the Penfield tube method, was 9.8 per cent and the moisture driven off by drying at 105° C. in the standard method for approximate analysis was only 4.9 per cent. Therefore, the sample retained 4.9 per cent of combined water that was driven off by heating to higher temperature in the volatile determination and was reported as volatile matter; deducting this amount from the per cent of volatile matter as determined gives 8.8 per cent for the actual combustible volatile matter.

Estimated yearly silt production. Estimates based on the ratio of current silt production to production of prepared coal at all the mines that were sampled in the four major divisions of the anthracite field fixes the total *annual production of silt at approximately 8,900,000 tons.*

Plants handling fresh-mined coal in the Wyoming Valley field produce about 13 per cent as much silt as prepared coal. In the Eastern Middle Field the ratio of silt to prepared coal is about 16.5 per cent, in the Western Middle Field 14 per cent, and in the Southern Field 17.5 per cent. At the collieries in the Western Middle Field where sampling was done, a comparatively large proportion of the coal was being drawn from stripping operations, and the proportion of silt may, for this reason, be lower than the average of the coal mined in this district.

Losses of fine coal in waste water. The quantity of coal lost in waste water discharged into the streams depends entirely upon the method of handling it at individual mines and has no relation whatever to geographic position or mining conditions. Furthermore, the extreme variation in conditons may be and often is found at adjacent collieries. Hence the average ratios of fine coal lost to prepared coal shipped in the different districts are of no significance when they are applied to individual collieries, but have been used only for estimating the total loss through silt-laden water discharge in the anthracite field as a whole. The law of averages and the number of observations make this estimate approximately correct.

At the collieries studied in the Northern Field the loss of fine coal in waste water discharged from the preparation plants amounted to 1.6 per cent of the quantity of coal shipped. In the Eastern Middle Field this ratio was 1.3 per cent, in the Western Middle Field is 2.7 per cent, and in the Southern Field 1.8 per cent. The total loss of fine coal in water discharged into the streams is approximately *1,150,000 tons a year.*

Screen analyses show that practically all this material is finer than the smallest of the present commercial sizes of coal and is comparatively high in ash content. At only three of the collieries which were examined was any appreciable quantity of coal of commercial size being discharged directly into the streams, and at one of these properties measures have since been taken to minimize this

loss. This survey of conditions showed that very little valuable coal is now being discarded directly from preparation plants into the streams.

Practically all the coal of marketable size which is being added to the stream deposits must be washing out of culm, silt, and rock banks that are subject to stream action or erosion in time of heavy rains and floods.

Quantity of Culm and Silt Stored in Banks in the Anthracite Region

The following table gives the quantity of culm, silt, and mixed material by fields in long tons.*

Field	Culm	Silt	Mixed	Total
Southern	37,745,000	36,815,000	10,000,000	84,560,000
Western Middle ..	43,785,000	40,735,000	17,175,000	101,695,000
Eastern Middle ...	2,430,000	6,200,000	1,385,000	10,015,000
Northern	8,125,000	8,035,000	1,795,000	17,955,000
Total for all fields	92,085,000	91,785,000	30,355,000	214,225,000

*These tonnages are not recoverable marketable coal. The material composing these banks ranges from 20 to 80 per cent combustible material.

Quantity of Culm and Silt in the Streams within the Anthracite Region

It is absolutely impossible to estimate the quantity of material in the streams in the anthracite region, but some of the larger deposits have been estimated and these estimates lead to a reasonable guess that in the streams in the anthracite region and leading from it there are accumulated at least 900,000,000 tons of material which contain enough coal to make them profitable for future recovery.

PRODUCTION OF FINE SIZE ANTHRACITE

Introduction

The methods of mining have more influence upon the production of small-size anthracite than any other mechanical cause. Improvements in mining methods have not kept pace with improvements in the preparation and handling of the coal after it has been mined.

Coal beds from 18 inches to 100 feet thick are mined in the anthracite region of Pennsylvania. The coal varies in hardness and physical character. The coal beds are flat in some localities and pitch to a maximum of 90 degrees in others. In many localities the pitch is reversed. The beds are broken and crushed by the stresses which were present when the rocks were folded.

In the Northern Field the coal is very hard. The beds lie in a basin which is roughly canoe-shaped. In the center of the field the beds are comparatively flat, but on the edges of the field the beds rise toward the mountain and steep pitch mining is necessary. In the vicinity of Nanticoke and in the general southwest end of the Northern Field folding and faulting has occurred and the coal beds are badly distorted. Large faults and displacements make mining difficult and the coal beds have been crushed.

In the Eastern Middle Field the coal lies in small canoe-shaped basins with steep pitching flanks. In some localities the basins have flat bottoms but in general the folding has been very sharp, and three-fourths of the coal which is mined occurs in steep pitches. The coal is as hard as that in the Northern Field, but the recovery is not so great. A large quantity of fine-sized coal is produced in the Eastern Middle Field because of the physical character of the coal.

In the Western Middle Field the coal is not so hard as in the Northern and Eastern Middle Fields. There is some flat bed mining in the district, but in general the coal lies on steep pitches.

The coal in the Southern Field has suffered much crushing, faulting, and folding. The beds have slid on each other and a large percentage of the coal is crushed. The coal is extremely friable and steep pitch mining, which is necessary practically throughout the entire region, adds to the percentage of fine sizes. The beds occur in basins, the bottoms of which are flat in small areas. Practically all of the coal is mined on steep pitches. In the northern fish-tail of the Southern Field the beds have slid on themselves so that a large percentage of the coal has been broken down to pea, buckwheat, and finer. The percentage of domestic sizes is very small. On the southern pitch of the Lykens district the coal is harder, but is soft compared to that of the Northern and Eastern Middle Field. In the central part of the Southern Field the coal

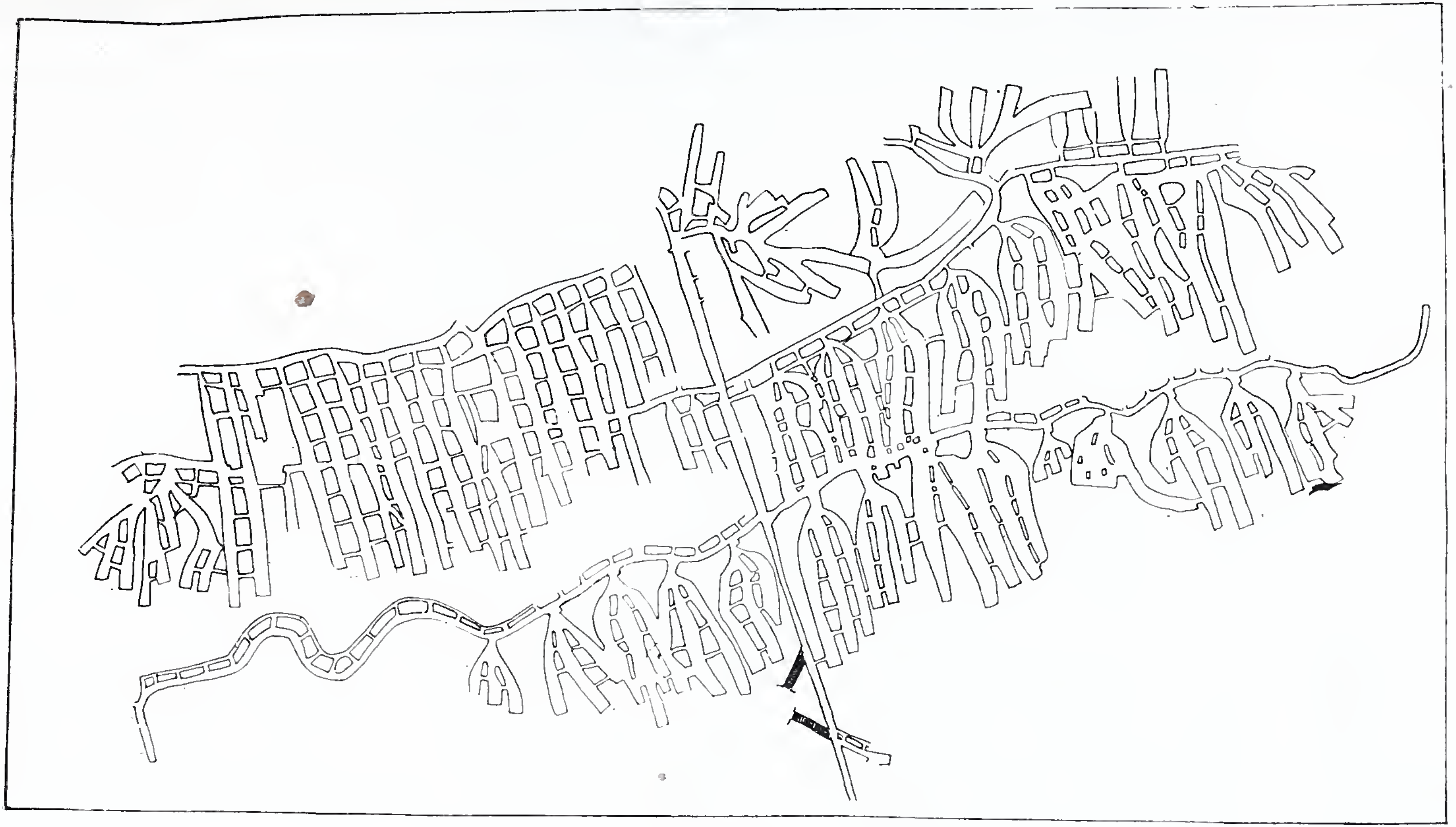


FIGURE 1
A layout for a drag line scraper in the Western Middle Field.

is fairly hard but a large quantity of fine sizes is produced. In the Panther Creek district the coal beds are very thick. The Mammoth bed has a maximum thickness of 100 feet in this area. It lies on exceedingly steep pitches and has been badly distrubed by folding and faulting.

Mining Methods

The room and pillar system of mining is mostly used in the anthracite region. In the earlier days of the industry no attention was given to efficient recovery of the coal. Only first mining was done. Long gangways were driven and rooms were turned off and worked to their limit. The pillars were left undisturbed as the operators thought that they would never want to recover them. As a result the roof has caved and the chambers are filled with fallen rock which makes it exceedingly difficult to go back now and recover valuable coal which remains in the pillars. In driving the chambers coal is shot off the solid. Holes 6 to 8 feet deep are drilled in the coal and filled with very heavy charges of explosives. The coal is blown down, and owing to the heavy charge a large quantity of fine-sized coal is produced.

The rooms stand from 18 to 40 feet in width, with two tight ribs to each working place. This of course means that heavier charges must be used in blowing the coal from the ribs. In the past this feature was not serious for coal was not as valuable as it is now, but at the present time it is necessary for the smaller sizes to pay at least part of the cost of mining domestic sizes. It is extremely desirable to obtain the largest percentage of domestic sizes possible. In order to produce larger percentages of domestic sizes some of the coal companies are using an undercutting machine. This machine makes a complete cut across the working face to a depth of 6 feet. It is then possible to break down the coal by a lighter charge of explosives. A larger percentage of domestic sizes results.

In the recovery of pillars which were left from former room and pillar mining it is customary to drive a pillar hole up through the middle of the pillar and then draw back the pillars. No mechanical means of undercutting is used. These holes are very narrow and all of the work is tight. A large quantity of explosives is necessary to blow down the coal. In many collieries it is not possible to drive pillar holes, particularly in the old workings, as the pillars are too thin. If a pillar hole is driven up in them they are weakened and a squeeze results. In recovering pillars of this type it is necessary either to take a slab off the pillar or clean up the old chamber so that a roadway can be laid parallel to the rib of the pillars. If the pillar is strong enough the slab is usually taken. In this method the quantity of fine sizes is usually less than that produced when a pillar hole is used. Best results are obtained when the old chamber is cleaned up and a roadway laid parallel to the pillar, for then the pillar can be drawn in its entirety from the upper end and as the weight of the roof settles upon the pillar the coal is loosened and less explosives are required to shoot it. A larger percentage of lump coal results.

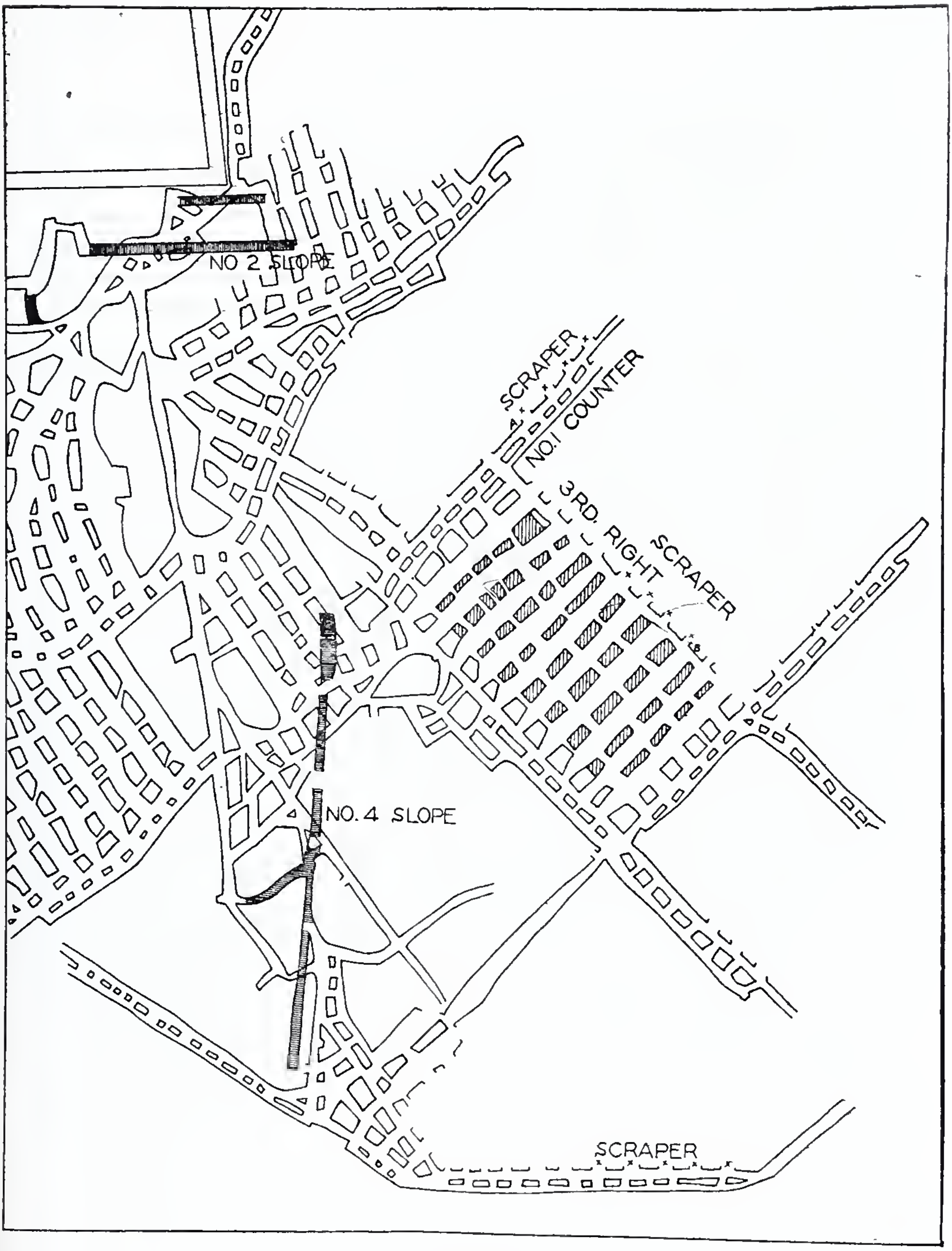


FIGURE 2
A mining system for a drag line scraper in room and pillar work.

In addition to the room and pillar method of mining a modification somewhat similar to longwall mining is being used. Instead of driving a single room 18 to 40 feet wide, the rooms are driven double or tripple and are from 60 to 100 feet wide. This gives a long face at the end of the room. The number of tight corners and the quantity of small size coal is reduced and less explosive is necessary. However, in this system of mining it is necessary to back-fill in order to support the roof. This method is used only in thin beds

where the quantity of back-fill is reduced to the minimum. Mining by this method is done in coal 5 to 6 feet thick, but it is general practice not to mine in this manner when the coal is more than 3 feet thick. In order to recover the pillars it is necessary to completely fill the old chambers in order to give protection to the men working on the pillars, although it is not necessary to use back-filling to any extent when the room is being driven.

Where this system of side rooms is used it is generally customary to undercut the coal with a mining machine. This again reduces the quantity of explosive used to break down the coal and even in thin coal where the mining machine is used it is found that the percentage of domestic sizes is not materially reduced although one-sixth of the height of the coal is cut away by the mining machine. This shows that by undercutting coal a much larger percentage of domestic sizes can be produced from a bed.

A semi-long wall method of mining anthracite has been experimented with in various forms. The variations in method are in the manner in which coal is handled from the working face to the gangway. At most places the coal is undercut, but in a few it is shot from the solid. At one colliery the coal is loaded by hand into a face conveyor which drags the coal along a trough and discharges it into the mine car at the end of the conveyor. This system of handling probably causes less degradation than the others. This installation is not perfect by any means because the coal is chipped and crushed somewhat when it drops a distance of 4 feet from the conveyor to the mine car. This breakage could be eliminated by placing a pan at the end of the conveyor which would permit the coal to slide gently to the mine cars.

Another semi-longwall operation is in use in the Northern Field. This system of coal handling is not good, although the coal is undercut. In order to save breakage the men handle the coal by shovel from the working face to the end of the mine track and then load it by hand into the mine car. The coal must be shovelled three or more times before it reaches the mine car. Each time the coal is shovelled much breakage results.

Another method of handling coal at the face is by drag scraper. After the coal has been undercut or shot from the solid a scraper similar to a snow plough but operating in the reverse direction is used. Instead of pushing the coal away it gathers it between the sides. The scraper is dragged along the length of the face to a discharge platform where the coal is dropped into the mine car. This could be entirely eliminated if other methods of handling the coal were used. At many places throughout the anthracite region the scraper is small and a couple of men can pick it up and throw it around. When the scraper is picked up and thrown into position it falls on large lumps of coal, cracks and breaks them into smaller pieces. There is very often a milling of the coal in the scraper as it passes down the chamber or across the face. This milling not only breaks the coal but it continually brings fresh coal into contact with the floor of the chamber and the resulting friction between the moving coal and the floor causes a further degradation of coal.

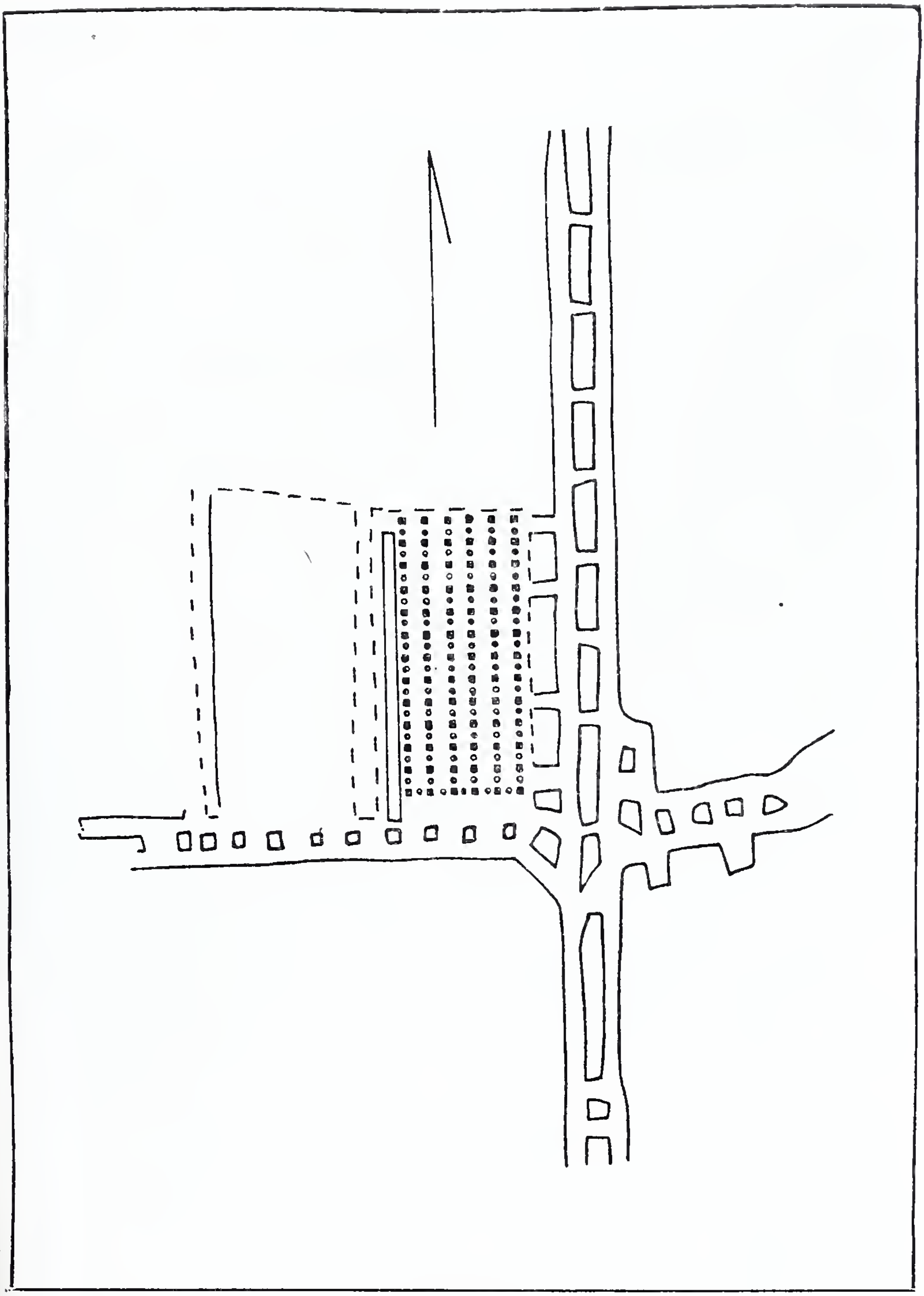


FIGURE 3
A longwall system used in the Northern Field.

Another method of handling coal at the face is by a certain type of belt conveyor. This belt is operated by a hoisting engine. It is dragged along the longwall face and the coal is loaded into it by hand. The coal moves along with the belt and as the belt is wound up the coal is discharged into the mine car. Probably there is less breakage with

this system of loading than any of the others which have been described, but there is a limit to the places in which a belt of this character can be used.

A new method of handling coal at the face is by the jigging conveyor. One colliery is using this method. The coal is loaded by hand into the conveyor and taken by it to the loading point. The movement of the coal in the conveyor is very gentle. There seems to be little or no degradation of the coal on its way from the working face to the mine car, but the degradation due to shovelling can possibly be considerably reduced by the installation of a self-loading device which is being used very successfully in soft coal mines in this country. This device operates as a shovel in a man's hand but instead of picking up the small quantity of coal that a man would on a shovel, it picks up a large quantity and the coal which comes in contact with the large shoveling device is less compared with that coming in contact with the hand shovel. There should be less degradation due to friction than there is when the coal is shovelled by hand. In beds where the pitch is too great to run the mine car up to the face, or where the coal is too thin to warrant the mine car going into the working face and where it would be too expensive to brush the roof to permit the entrance of the mine car, a buggy car is used. After the coal has been shot down it is loaded by hand into the buggy and then transported to the gangway where it is unloaded on a platform and shovelled by hand from the platform into a mine car. This additional handling of the coal increases the amount of degradation.

A system of mining called continuous first and second mining on steep pitches is used in the anthracite region. This system is closely related to the longwall system as all the coal is removed in practically one operation. The breasts are driven up the pitch in 50 foot centers and the broken coal stands on the boxes which support the roof. When three breasts are completed, additional breasts are driven up and the coal is allowed to stand in the boxes. The breasts in the pillars are driven in steps, that is, the breast near the outside limit of the workings keeps in advance of the next breast and so on, and when the first pillar breast reaches its limit the coal in the breast to the right, provided the retreat is in the direction to its left, is drawn back when the breast in the second pillar reaches its limit. Then the coal in the breast in the first pillar is drawn. This means that at least two and sometimes three boxes of coal act as pillars for roof support between the point where men are working and where the coal has been drawn. Although this method of mining gives complete extraction, much degradation occurs. One of the unique features in the operation of this method is to rest the ends of the boxes in the breasts against a pillar of coal between the haulage gangway and the monkey heading. This gives additional strength to the boxes, but as there is no outlet at the lower end of the box, the surplus coal that is produced in mining by this method must be sent down the manways, which means that the coal bounds from timber to timber and much degradation takes place. When it is necessary to draw the coal from the breasts, instead of emptying it directly into a mine car through a chute, it passes along the monkey drift for a short distance and then goes into a chute from which it is dropped into a mine car. The pressure of the coal in the box, its movement from

the hole which is made in the side of the box and its travelling through the monkey drift into the chute and into the mine car cause some breakage. There is not so much breakage in the pillar coal, or pillar breasts as they are called, because the coal is dropped from the bottom of the box directly into the chute and then into the mine car. The coal has less distance to travel and therefore less degradation takes place.

Practically no longwall mining is being done in the Eastern Middle Field. A large number of jigging and shaking conveyors are being used in room and pillar work. A few scraper loaders are being used in room and pillar work, operated in batteries of four rooms. Most of the work is of the old pillar and breast mining on steep pitches. This system of mining is very likely to cause considerable breakage when the coal stands in the boxes. Squeezes very often bring weight upon them, and there is a tendency to crush the coal. If the closed type of box is used the surplus coal must be slopped over the top and it falls down the manway and is badly broken. If the open type of box is used (with a battery and chute), the coal is drawn through the box and none of it falls down the manway, and breakage that occurs is due to the friction of the coal on the walls of these boxes and the rubbing together of the pieces. If a breast is 150 feet long and on a pitch of 45° or more, there is considerable pressure on the lump coal that lies in the bottom of the boxes, and when the coal is drawn from the boxes a considerable quantity is broken, if the coal is friable. However, in the Eastern Middle Field the coal is fairly hard so that the degradation is considerably less than in the Southern Field.

Stripping is another type of mining that has produced large quantities of coal from the Eastern Middle Field. Of course this system can be used only when the coal lies near the surface, and the cover is relatively thin. When the surface rock and earth is removed and the coal is exposed, it is shot, and is then loaded by steam shovels into cars for transportation to the breaker.

Mechanical shovels used for this work produce larger lumps of coal than can be produced by man power. Therefore, degradation of the coal is considerably less. Breakage, instead of occurring in the bed, occurs in the breaker, where the coal is crushed by specially designed rolls.

Comparatively little longwall work has been done in the Western Middle Field. Some experimental work has been done, and a few of the coal companies now feel that they can use a longwall system of mining and obtain better results than they have had with the old pillar and breast system. At some of the longwall faces drag scrapers are being used with their resulting loss of coal by degradation. However, at one or two places the belt conveyor is used with excellent results according to reports received from the coal companies. In some of the flat districts of the field the ordinary room and pillar method of mining is being used. A drag scraper and shaking chutes transport the coal from the face of the chamber to the gangway. This saves the cost of brushing the roof in the low beds of coal, and gives a better method of haulage, which allows more continuous operation of the working face than if the mine car was placed in the face to be loaded by hand. When a shaking chute or the scraper

loader is used, trips of mine cars can be placed on the gangway and dropped into position and loaded. The men are not delayed in loading coal, because they do not have to wait for the locomotive or the mule to remove the loaded car from the working place and bring in an empty. Even with the advantage of this greater loading capacity, the loss due to dragging of the coal may not compensate for the saving by continuous operation of the working face. An appreciable saving will result by the use of the shaking chute or conveyor for there is practically no loss in the breaking up of the coal and a saving results from continuous operation.

Mining conditions in the Southern Field are considerably different from those in most of the other fields. In the western end of the northern fish tail, the coal is very friable; in fact it is so friable that one of the large companies operating in this district has driven its gangways in the underlying conglomerate and tunnels up to the coal so that a minimum number of gangways will be in the bed itself. They found it necessary to do this because the coal slides or runs, crushing the timbers and making it almost impossible to maintain the gangway for a considerable time. A monkey drift is driven above the short gangways in the coal. Raises are made to the bed above from this monkey drift, the coal shot and allowed to run. So far it has been impossible to control the running of the coal, and as a result a considerable quantity of fine sizes is produced. If there were any way to control this running and to load the mine cars without breakage there would be a very important saving, because of increased percentage of domestic sizes. The same physical conditions apply to all of the coal in the Short Mountain district. At the other collieries in this district they drive their gangways in the coal and maintenance is extremely difficult. Most of the collieries are using the old breast and pillar system of mining.

In the Minersville district a considerable quantity of flat coal is found and shaking chutes and drag scrapers are being used in room and pillar work.

In the eastern end of the Southern Field where the beds are very thick, modified systems of breast and pillar mining are used, and, as far as possible, means are taken to reduce the breakage of coal. As yet, no important advance has taken place in mining methods that reduce the amount of degradation. A new method has been submitted to a large company in the Panther Creek district. It is as follows: (1) Gangways, chutes and stairways to be driven in coal only. (2) Breasts next to tunnel pillar to be driven at regular intervals directly up the pitch from the gangway to the airway; broken coal to be drawn and a concrete mixture to be poured in, forming concrete pillars; this system to be continued along the gangway. (3) Tunnel pillars to be extracted and replaced with the concrete mixture; except places for air connection between gangway and airway (to be made in new concrete pillar). (4) Coal pillars between the concrete pillars to be entered by driving up a center chute to level above and robbing down. (5) Above airway first breast to be driven 10 to 12 feet wide 80 feet inside of tunnel pillar to the upper level; coal to be drawn and concrete mixture poured in from upper level; mine refuse being used in the mixture.

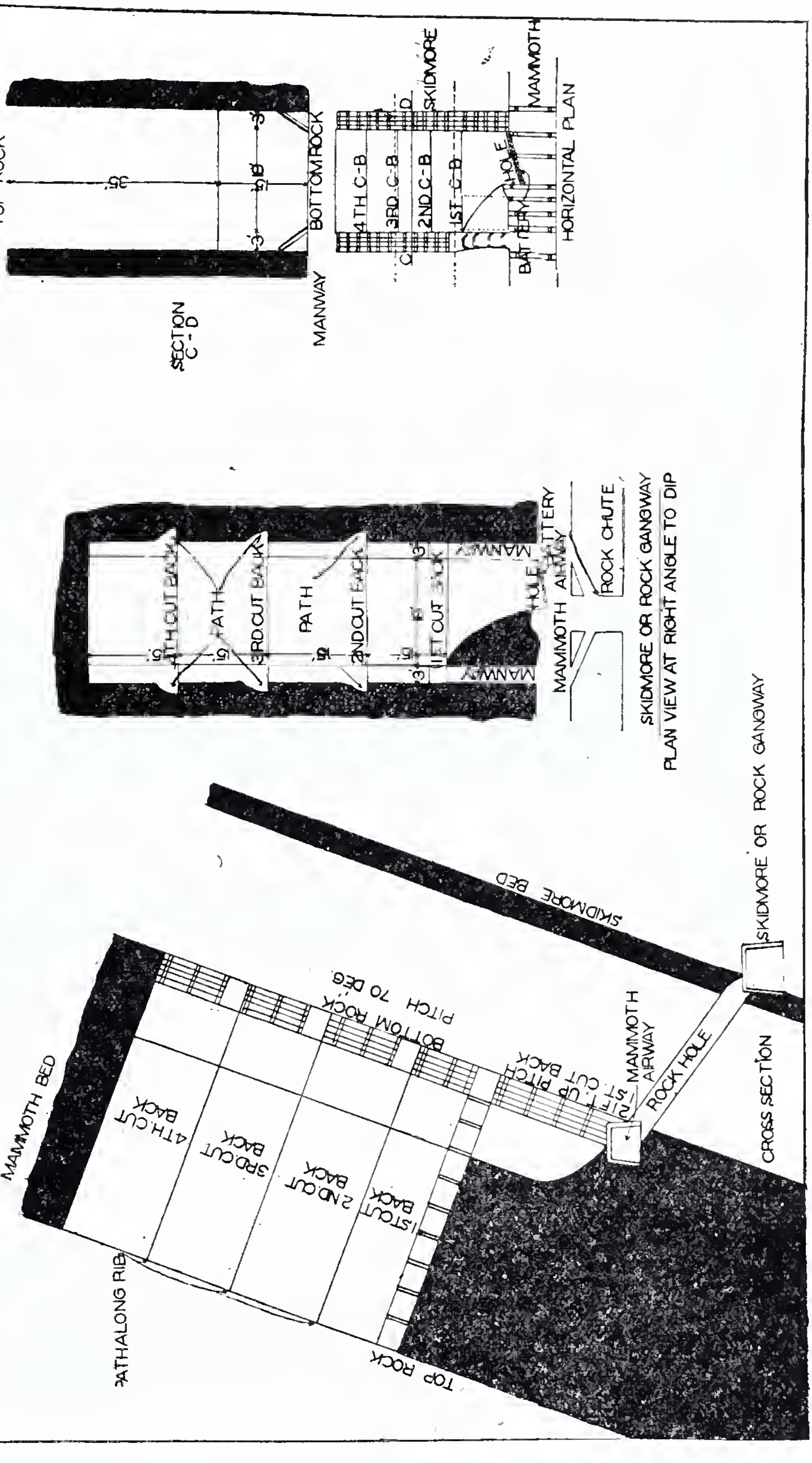


FIGURE 4
Steep pitch mining in the Panther Creek District.

The methods that are now in use in the anthracite region tend to produce a large quantity of fine sizes. If the undercutting machine were more generally used the percentage of small sizes would be decreased. More of the coal would break down into lump.

Numerous tight corners exist in the present systems of mining. These corners require large quantities of explosive to break the coal down. The coal is crushed down to small sizes before it leaves the mine. If a larger percentage of the coal could be produced from longwall faces, the percentage of tight corners per linear foot of face could be materially reduced with saving in explosive, and a larger recovery of domestic sizes would result.

In the steep pitch workings of the anthracite region, the lack of care in handling the coal causes much degradation. If the system of working were changed to correspond more with those in the European coal fields where the coal is not allowed to drop, but is conveyed gently from the working place to the mine car, less degradation would occur.

Suggested Methods of Mining Anthracite

The following descriptions of mining methods which are now in actual use in Germany, France, and Belgium are presented to the anthracite industry as suggestive methods for use both in flat workings and on steep pitches.

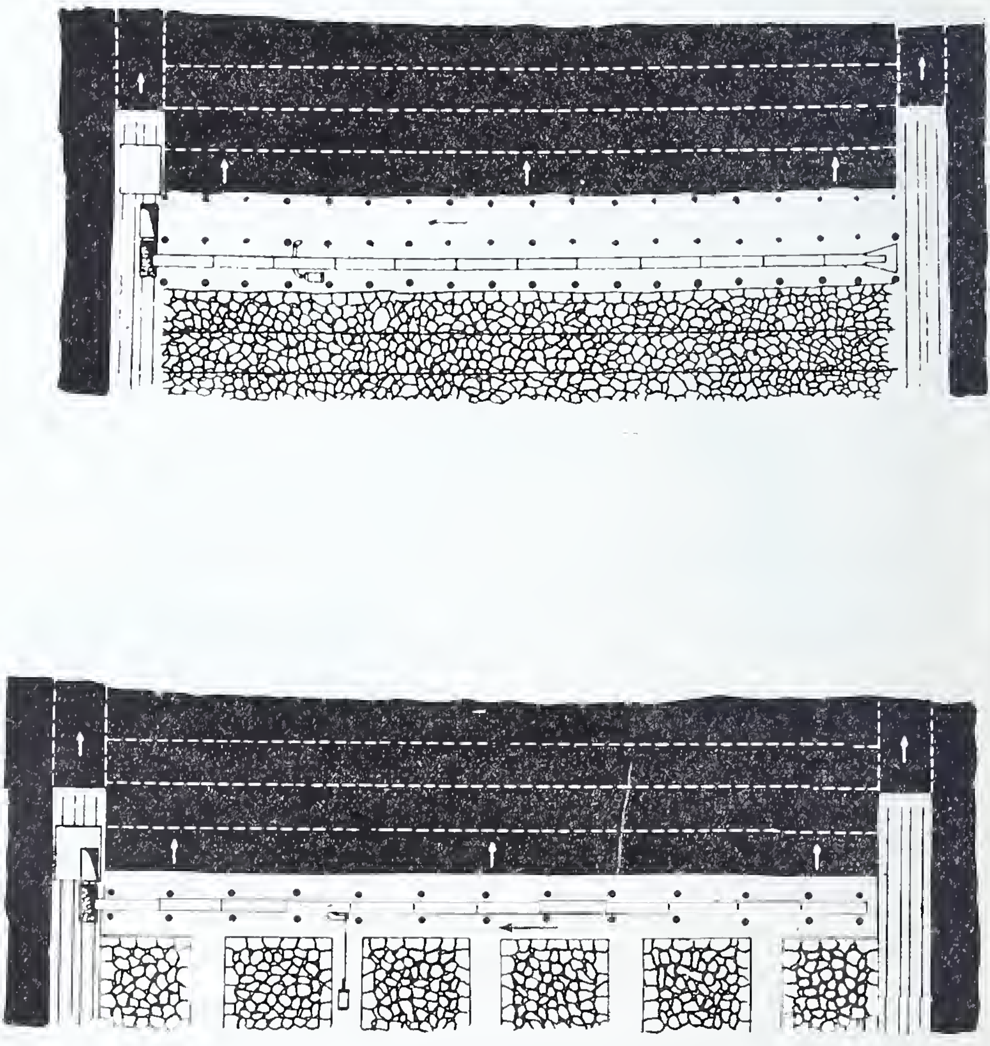


FIGURE 5
A simple longwall operation using face conveyors.

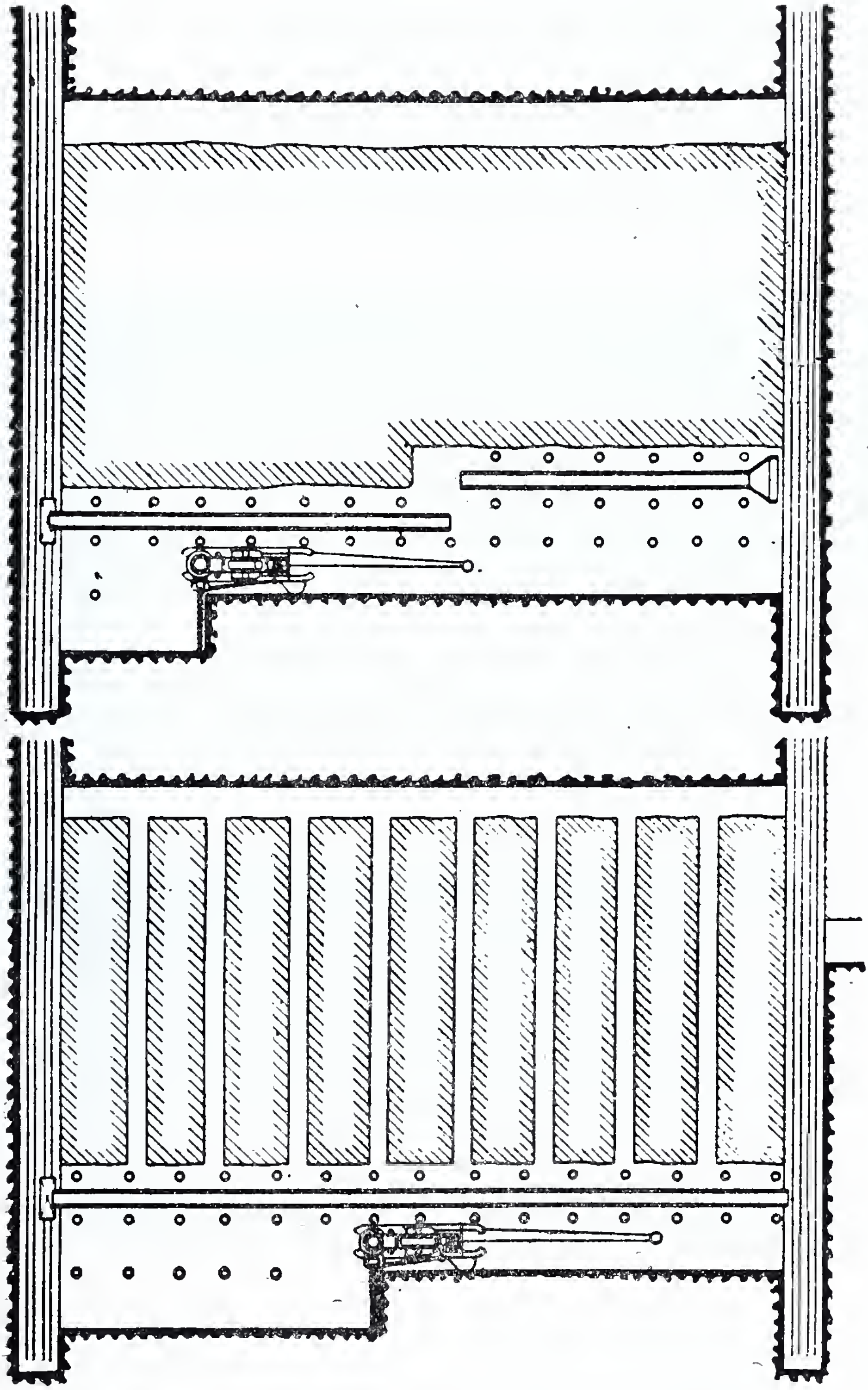
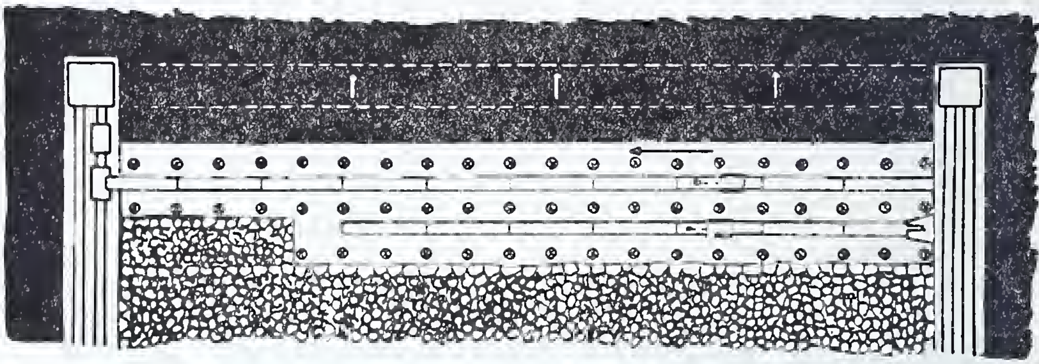


FIGURE 6
A longwall method using undercutters and face conveyors.

Figure 5 shows the simplicity of a longwall mining method when it is combined with some types of face conveyors. This method can only be used with partial or total back filling. Some of the material may be secured from the bed itself, but the remainder must be brought from other parts of the mine or from the surface. A good filling has many advantages; it creates a good barrier between the air currents, it is safer for the men, and reduces fire dangers. Back filling makes rock work and timber handling easier, and decreases the movement of the roof. It also helps indirectly in mining the coal by distributing roof pressure.



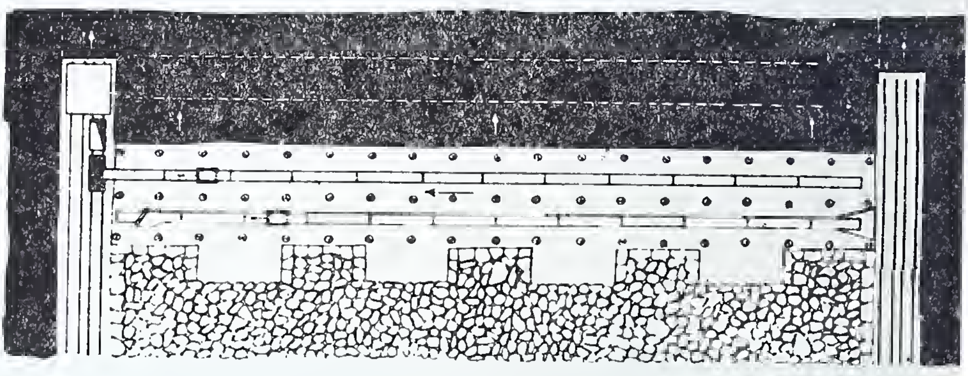


FIGURE 7
A longwall face with two conveyors. One for coal and the other for filling.

In comparing this system of mining with the older methods, the following advantages will be found when development is complete.

1. Only two roads exist, the lower one for the transportation of coal, and the upper one for ventilation.

2. Repair and maintenance costs are reduced. It increases the saving on tracks and timber.

3. Ventilation is easy to establish, for there are no curves or corners where gas can accumulate. The production per man will be increased by better ventilation. The impression of safety will be felt by the miners and the air in which they work will be fresher.

4. Mining is concentrated and can be better supervised.

5. Transportation of rock for filling is greatly facilitated because the same conveyors can be used both for the transportation of coal and rock.

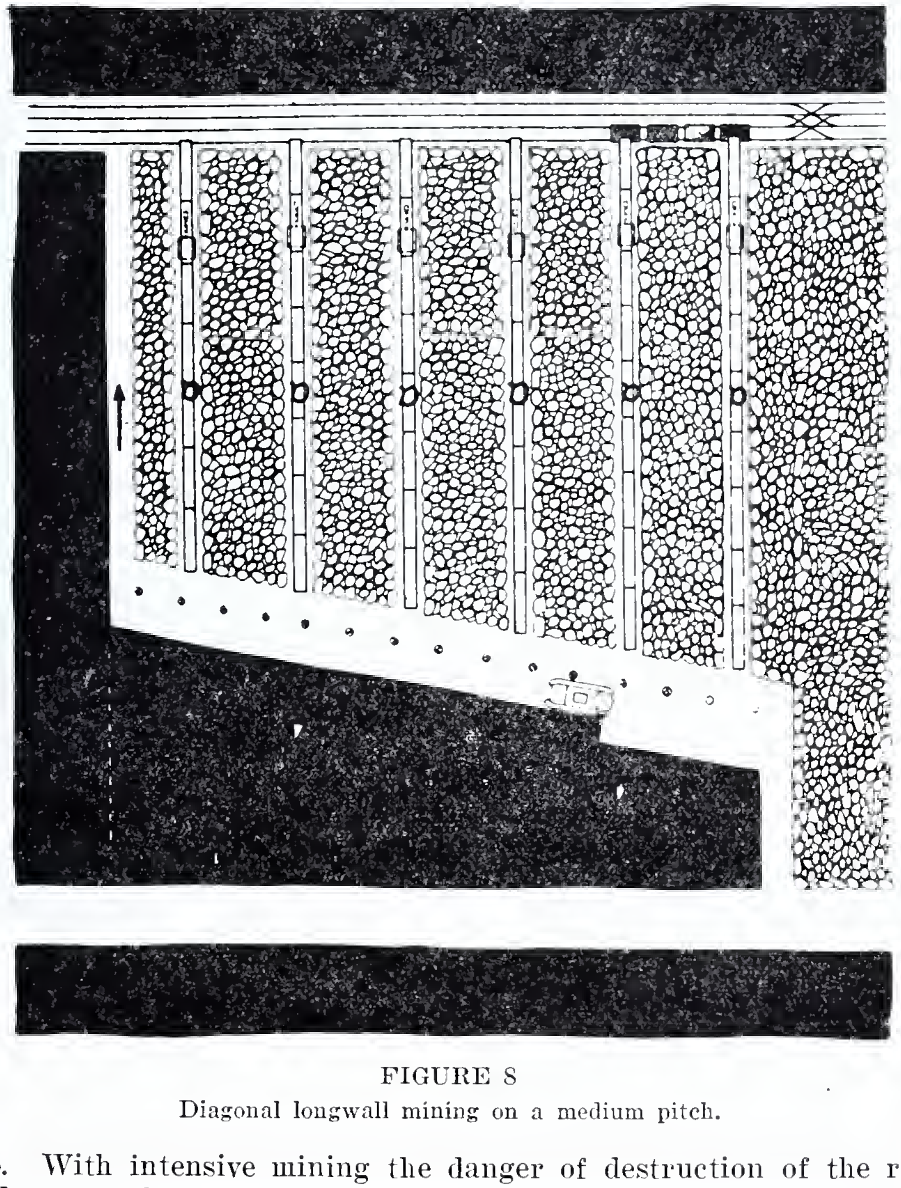


FIGURE 8
Diagonal longwall mining on a medium pitch.

6. With intensive mining the danger of destruction of the roof is decreased because the roof does not sink as rapidly as the coal is mined. A larger percentage of domestic sizes of coal can be produced because the coal is not submitted to pressure for a long period.

7. The number of inclines or planes can be reduced, which removes a source of danger, reduces maintenance and repair costs, and damage to the mine cars.

8. The coal is handled more directly, without much reshoveling, and along the shortest route between the place where it is mined and the main road.

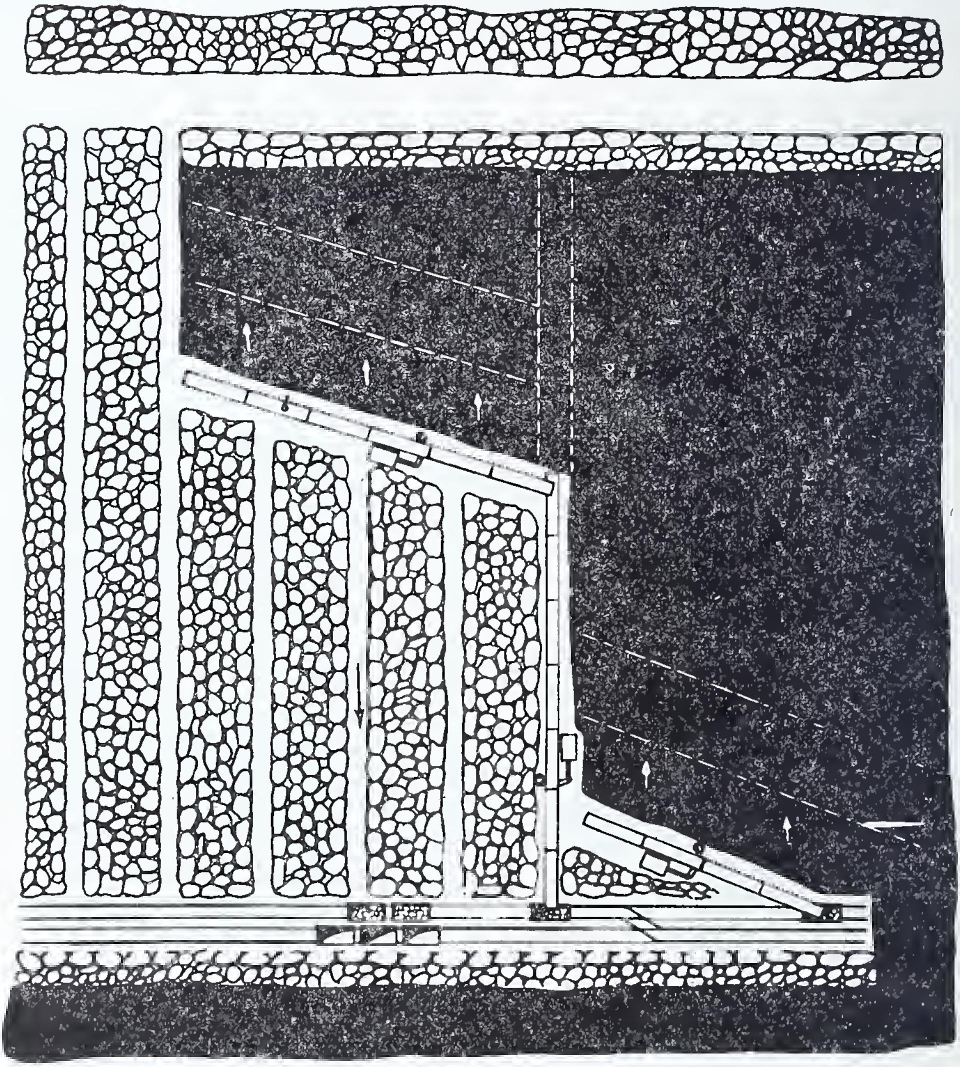


FIGURE 9

A variation in the longwall method, showing a better arrangement of conveyors.

9. By decreasing the number of men employed per ton it requires less houses on the surface.

10. Work can progress much more rapidly and a large production can be reached sooner.

A variation of the method previously described is shown in figures 6 and 7. Two conveyors are used, one for transporting coal and the other for rock. This method can only be used where the roof is good and the bed is over 7 feet thick.

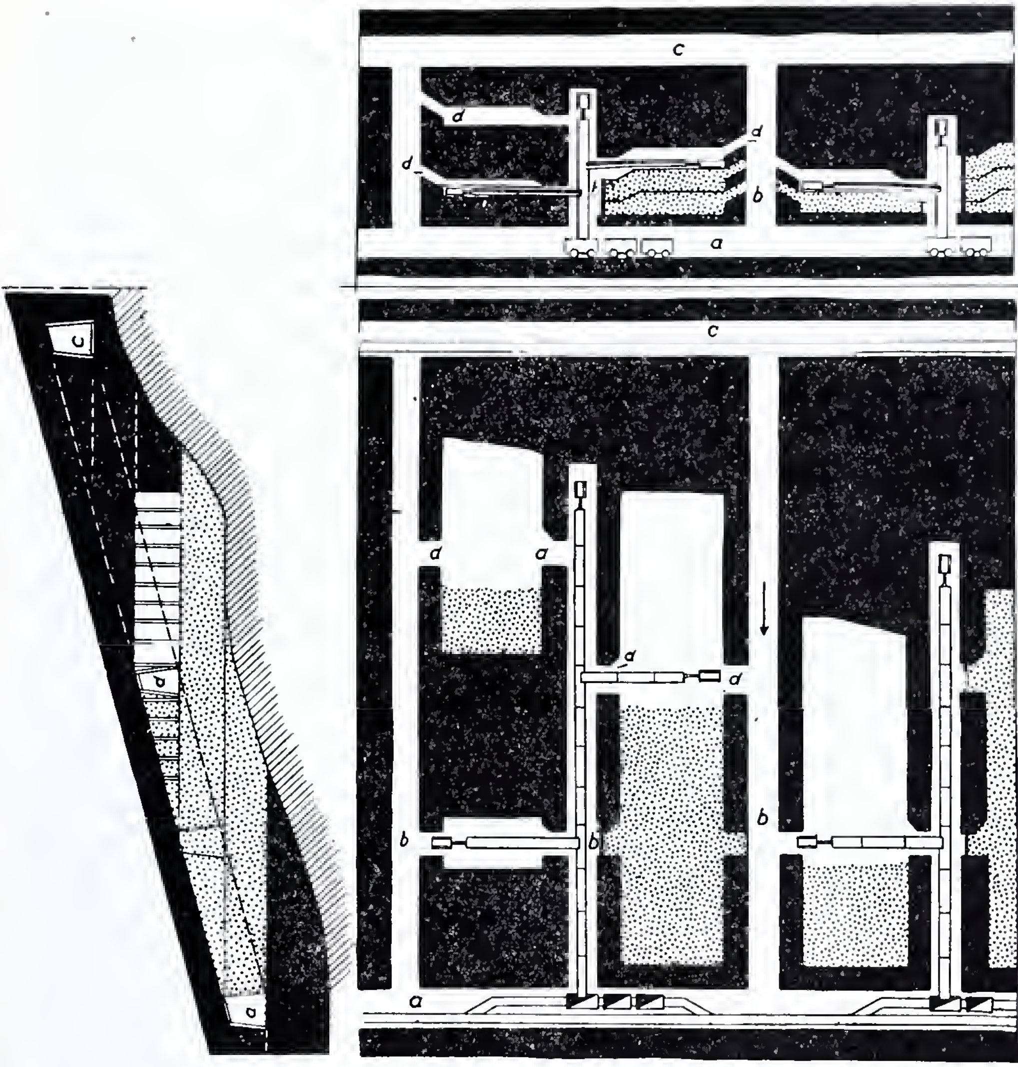


FIGURE 10
Very thick bed being mined long wall with back filling.

Preparation of Anthracite

The preparation of anthracite has evolved from the manual labor of separating coal from slate by hand underground to extensive and complicated operations housed in a breaker costing as much as $2,000,000. The first mining of anthracite for commercial use was in 1808. For 20 years or more the coal was cleaned by hand underground. In 1830 a wrought iron hand rake was used for separating the large sizes from the fine ones. At that time there was no market for the fine sizes of coal. The years following 1830 saw attempts made to size and clean the coal outside the mine. The coal was dumped upon a perforated cast iron plate. Men with sledge hammers broke the larger pieces down into suitable sizes for the market. The smaller sizes of coal which passed through the perforations were discarded.

In 1844 J. S. Battin, of Philadelphia, invented the roll crusher. In the same year the first anthracite breaker was built at Miners-

ville. This breaker crushed and cleaned 200 tons of coal per day. Roll crushers and circular screens were used in the preparation of the coal. This breaker was considered such a success that 13 more breakers were immediately erected.

It was not until about 1900 that any attention was given to the prevention of unnecessary breakage of coal during preparation. The demands upon the anthracite trade for a sized fuel have been urgent, and in order to make the trade successful it has become necessary to size coal with minimum breakage. A great deal of experimentation has been done by the various coal companies, and rolls of suitable size and design have been perfected. There are many types of rolls on the market, each suitable to the coal which is being prepared at the breaker. Various kinds of teeth are being used by the anthracite producing companies, the old type spear tooth, the Hawkbill tooth and the hollow ground tooth. It is believed that the hollow ground tooth gives more efficient fracture results than the other types. The hollow ground tooth has four cutting edges. The areas between the cutting edges converge to a point and are concave, so that the only part of the tooth which comes in contact with the coal is the cutting edge. The older type of tooth presents an unbroken surface to the coal and a grinding action instead of a cutting action results.

Very little if any separation of coal from impurities is now done in the mines. The entire product, coal, slate, bone and clay is hoisted to the top of the breaker and the process of cleaning and sizing begins. The difficult working conditions underground, particularly where pitches are steep, make it necessary to haul all of the material to the surface.

Screening

Anthracite was first screened on a revolving screen which was pitched at an incline of about $\frac{3}{4}$ of an inch to the foot. The coal was fed in one end and came out the other. The first objection to this screen was its small capacity. In 1860 a double roller screen was made which had a larger capacity, but it was inefficient in separating pea and smaller sizes. In 1880, shaker screens were installed. They were complicated and repair bills were high, although they were efficient and had good capacity. Improvements have been made in the shaker screen and they have been used extensively. The Parrish flexible-arm shaker is now used practically to the exclusion of all other types of screens.

Jigging

A jig is a mechanical device for removing and separating the impurities from coal during the process of preparation for market. Practically all of the coal up until recent years has been prepared by jigging. Several other processes for the preparation of anthracite are discussed at another place in this chapter. The coal which is to be run through a jig can be wet or dry, clean or dirty. The material can be of any size. The principal of separation upon which the jig is based is the difference in specific gravity between coal and impurities. Practically all the impurities in anthracite are heavier than the coal.

Seven important types of jigs are in use in the anthracite field. Other jigs having some particular merit for the preparation of a certain type of fuel are in use at a few breakers. The Reading, Lehigh Valley, Delaware, Wilmot-Simplex, Elmore, James, and Riley-Knapp are the most important jigs. It is not the purpose of the writers to describe each of these jigs. The principal of operation is practically the same, with variations to suit certain conditions. The following is a description of the operation of the Lehigh Valley jig which is used extensively in the anthracite regions. The coal after it has been sized is fed into the rear of the jig. A coal regulating gate governs the flow to the jig grates. Water in a plunger compartment is made to rise and fall by the upward and downward motion of an eccentric driven plunger. The water rises and recedes through perforations in the grate plates. The material which is being jigged rises and falls with it. The jig grates are set on a pitch of about $\frac{1}{4}$ inch to the foot and pitched toward the front of the jig, and upon which the agitation caused by the water moves the material to a point of discharge where it overflows into the coal and slate boot. While the agitation is going on, the coal which is lighter than its impurities, is raised to the top of the pit and the heavier impurities settled further with each stroke of the plunger to a point as close to the grate as it is possible to get within the short time which it is agitated. When the slate conveyor stops or the discharge of slate from the jig grates is stopped there is no escape for the slate and the accumulation of this material on the grates grows thicker. An automatic slate discharge device has been installed to regulate the quantity of slate which is discharged into the boot by each stroke of the plunger.

The Delaware jig is a modification of the Lehigh Valley jig. A lifting plunger takes the place of the coal conveyor. In the Simplex jig no plunger is used. The material enters the jig from the rear and flows upon a pan which moves up and down in a tank containing water. The agitation of the pan containing the material produces practically the same effect as that obtained in the Lehigh Valley jig.

Other Methods of Cleaning Anthracite

There are other methods of cleaning anthracite that have assumed importance within the last few years. A brief description of each of these processes will be given.

Chance process. The principal of the Chance process is the floating of coal on or in a fluid mixture of sand and water in which slate and other refuse sink.

Figure 11 illustrates the equipment used in this process. This equipment consists of a coal separator filled with a fluid mixture of sand and water with an overflow to permit the coal to leave the separator. A desanding screen removes the sand and water from the coal. A classifier pipe connected with the base of the cone, an upper slide valve, a refuse chamber, a lower slide valve, a slate sump, and a scraper line to remove the refuse are other parts of the equipment. Screens desand the slate. A sand sump to which all the sand and water from the desanding screen is conveyed is

usually located near the cone. A sand pump is used to pump the sand and water back into the cone. Water is furnished for the agitation of the sprays and for preserving the fluid mixture of sand and water.

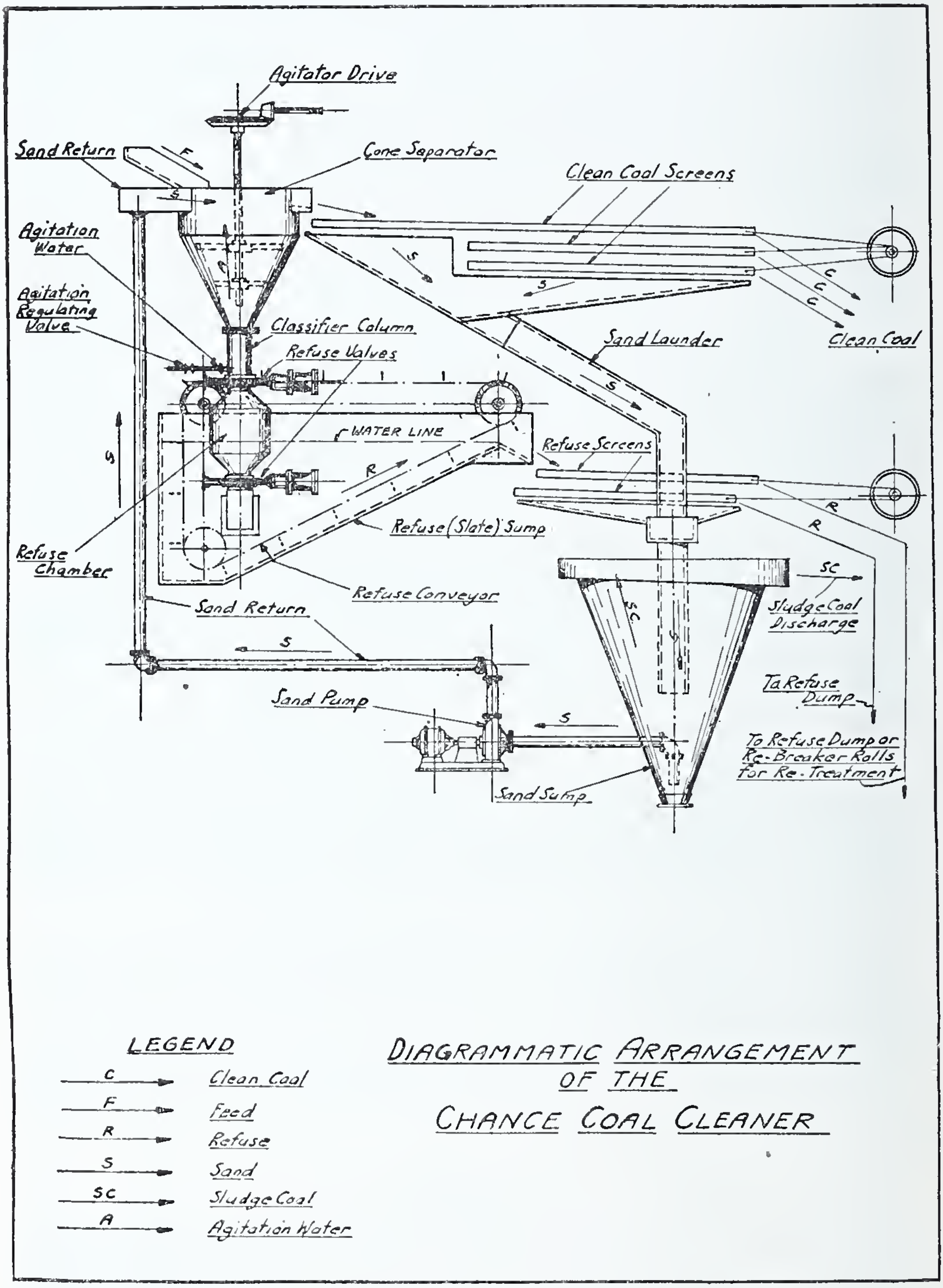


FIGURE 11
Diagrammatic arrangement of the Chance coal cleaner.

Coal fed into the top of the fluid mass in the cone floats at or near the top of the fluid mass and flows out of the separator together with the fluid mass with which it is mixed. The slate sinks and is trapped out by the alternate opening and closing of two

slate valves; the velocity of the upward current in the classifier permits the slate to fall and prevents much sand from passing out with the slate. The slate falls into a sump from which the scraper line elevates and removes it. It is taken over a desanding screen and afterwards goes into the rock bank.

The mixed coal, sand, and water flowing out of the separator pass over a desanding screen and then to the shaking screens for sizing.

Sand and water from both coal and slate desanding screens and from additional barley coal desanding screens go to the sand sump, in which the sand settles and is pumped directly back to the top of the separator. The clean water overflows at the top of the sand sump and goes to the clean water pump for reuse.

One cubic foot of water weighs 62½ pounds. Water has a specific gravity of 1. If enough sand is added to the water to cause 1/3 of the water in the bucket to overflow, the bucket will then contain ⅔ cubic foot of water and 1/3 cubic foot of sand. If the sand is ordinary quartz sand like seashore sand it weighs approximately 54.2 pounds per 1/3 cubic foot. The two-thirds of a cubic foot of water weights 41.7 pounds. The mixture of 1/3 sand and ⅔ water weighs 95.9 pounds or approximately 1.53 times the weight of a cubic foot of water. Hence the specific gravity of the mixture is 1.53. If this mixture is agitated to prevent the sand from settling, the fluid mass or mixture will float any material having a specific gravity which is less than 1.53. Any material having a specific gravity greater than 1.53 will sink. This is true whether the materials are coarse or fine, provided they are coarser than the grains of sand.

If the agitation of the mixture is caused by introducing water through perforations in the bottom of the container, it will be found that too great a flow of water will force the sand grains apart and some of the sand will overflow with the water until the agitation no longer forces the grains farther apart. The condition will remain constant and no more sand will flow out of the container. If some of the sand has been lost out of the container the mixture no longer weighs 95.9 pounds and it will therefore have a specific gravity less than 1.53. On the other hand if the quantity of water admitted through the bottom of the container is less than that necessary to keep the grains of sand evenly distributed throughout its entire volume, the individual grains of sand will fall. It will draw closer together until an end point is reached because of the water flowing upward between them. Under these conditions the container is no longer filled with a fluid mass because the upper part of the container holds water only. The mixture of sand and water occupies only a portion of the entire volume of the container. It is no longer in the proportion of 1/3 sand and ⅔ water. Thus it is apparent that the specific gravity of the mixture is increased by decreasing the quantity of water used for maintaining the agitation, and it is decreased by increasing the upward current of water.

In the Chance process water is controlled by means of a valve and by the use of sea sand or any other sand having a constant specific gravity. The specific gravity of the mixture can be produced and maintained with much certainty.

The Chance process is successfully used on all sizes of coal down to and including barley. Some other method of preparation must be added to treat No. 4 buckwheat and silt.

The principal objection to the Chance process is the bank loss, or loss of coal on the waste heap. This loss is being reduced as the mechanics of the process are being perfected. The erosive effect of sand on the various parts of the machine is very destructive. Replacements are frequently necessary. Adjustments have been made in the mechanics of the process to eliminate as much equipment as possible that is subject to erosion by the sand.

A breaker equipment with a Chance separator is much cheaper to construct than the ordinary jig breaker. A jig breaker may cost $400,000 and a breaker with a Chance separator approximately $275,000. The Chance separator is very compact and much less construction is necessary to house the entire operation than a jig breaker.

Conklin coal cleaning process. This process has been experimented with but there are no installations in operation at the present time. The Conklin process is based upon the same general principle as the Chance process, differing from it chiefly in the size of particles used for producing a fluid of the proper specific gravity and in the absence of agitation to maintain the particles in suspension. The process consists of producing a mixture of particles smaller than 200 mesh and having a specific gravity of approximately 3.0, mixed with water in such proportion that the fluid mixture will have a specific gravity of approximately 1.7. This fluid is maintained in a rectangular tank with a screw conveyor which operates in the bottom of it and removes the slate that sinks to the bottom. A flight conveyor removes the coal that floats on the fluid mixture. The fine sized solids which are carried out with the coal and slate are removed by screening and washing. They are settled out in a thickener. A classifier is also required in the circuit to remove all material coarser than 200 mesh. Various materials may be used in the Conklin process to maintain the desired specific gravity. Dust from iron ore mills with a gravity of approximately 3.1 was used at Olyphant. Crude magnetite, pyrite and numerous other metallic materials could be used when pulverized to the proper form.

The Rheolaveur process. This process has been growing in popularity since its introduction into the United States. Its appearance in the anthracite fields has been comparatively recent and the installations are on the whole very satisfactory. The process consists of carrying the mixture of raw coal and slate down an inclined trough by means of a current of water. In the bottom of the trough are openings with specially constructed boxes beneath them. The slate which settles to the bottom of the trough drops through these openings and the coal is carried forward by the current of water. An upward current of water is injected through the openings by a device known as the Rheolaveur box. This upward current of water allows the slate to go through the holes without carrying the coal along with it.

The Rheolaveur box consists essentially of a sealed chamber below the trough. A swinging flap in the bottom of the trough is supported by water pressure underneath until a certain weight of slate

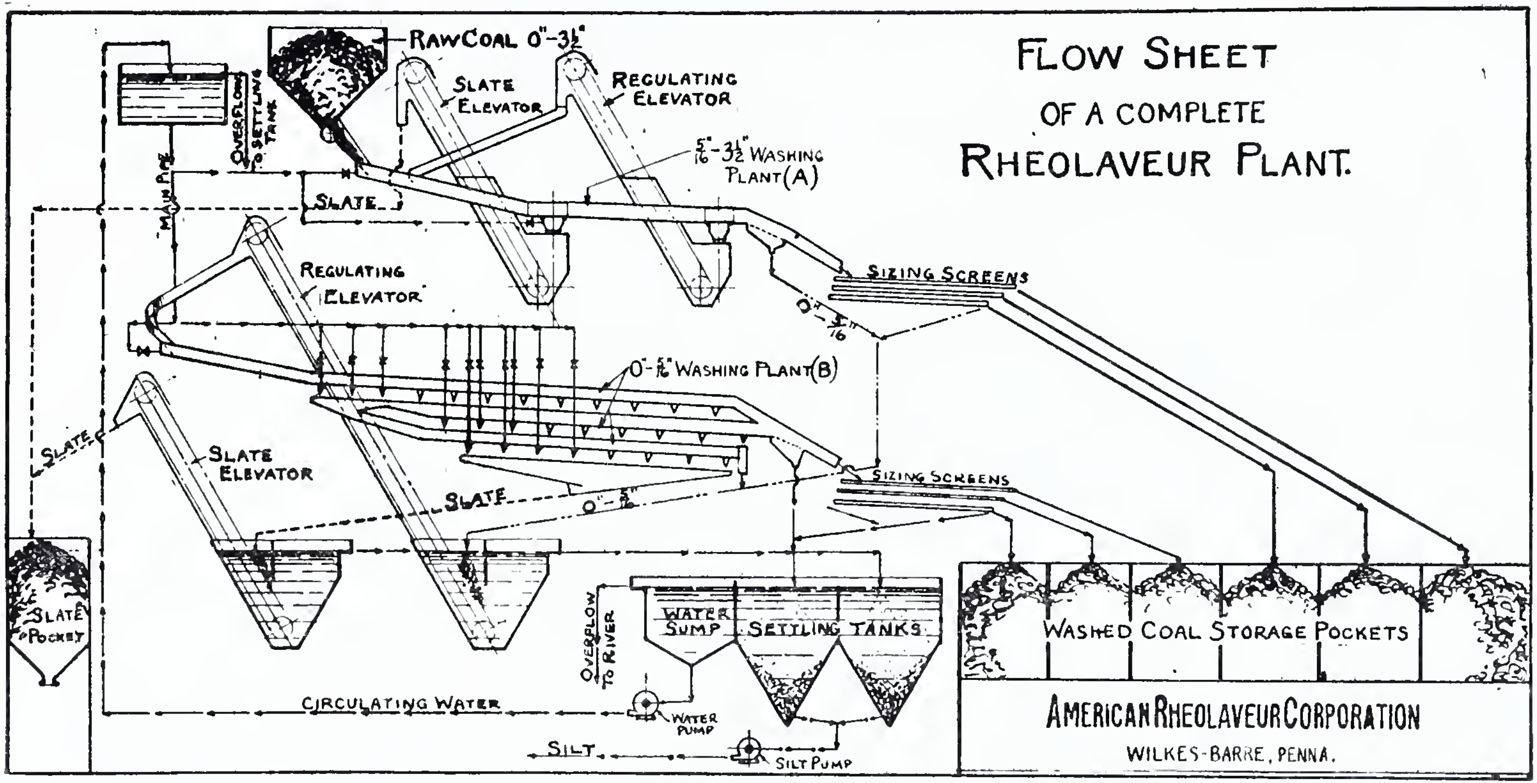


FIGURE 12
Flow sheet of a complete Rheolaveur plant.

is on it. It drops down and lets the slate fall through. At the same time an upward current of water passes through holes and prevents the coal from falling. The flap closes again as soon as a certain quantity of slate has passed. The removal of the slate progresses as the raw material continues along the trough until the last slot is reached, where the bone coal is discharged. The last boxes are so arranged as to discharge a product containing some commercially pure coal which is returned to the feed and retreated. The ultimate discharge is relatively clean coal, and the refuse is relatively free from coal. This is called rewashing in a closed cycle.

For washing coal coarser than .3 to .4 inch in diameter, a shorter trough is used as the coarser coal is more easily cleaned. The whole plant usually consists of one trough fitted with two chambers, the first of which extracts slate, and the second discharges a mixture consisting of bone and some coal. This mixture is run through the process again. The reasons for maintaining a material for rewashing are as follows: (1) to create artificially the flowing barrage of intermediate gravity materials between the poorest rock at the bottom and the pure coal above; (2) to regulate the variations of quantity and quality of the plant product; (3) to properly extract some pieces of material close to the separating gravity point. If the feed coal is constant both in quantity and quality the rewash will be composed of the same pieces.

In actual practice the sealed discharge plant can wash satisfactorily coal down to ¼ inch in diameter. The free discharge plant can wash from ½ inch down to 28 mesh of the Tyler scale. The silt plant takes care of materials from 1/16 inch down to 48 Tyler mesh. In the last units constructed in Europe it has been possible to bring these limits down to 100 mesh of the same scale. The material finer than 48 mesh is partially washed. Studies are being made to bring the limits of size as low as possible. Silt of the anthracite region originally containing 24 per cent ash and having a size between 1/16 inch and 48 mesh has been cleaned to 7 to 10 per cent ash.

Hydrotator. The hydrotator is particularly adapted to cleaning fine sizes of coal, that is from 5/16 inch in diameter to microscopic dust. For this purpose the hydrotator counter current system of coal washing can be used, but when all sizes from 5/16 inch and less are treated, it is necessary to screen between stages to remove the larger particles of coal as they are cleaned.

The hydrotator consists of a series of tanks as shown in Figure 13. For purposes of description it will be assumed that the coal to be treated is —3/32 inch in diameter. In each of the tanks is a set of hydrotator arms such as those shown in the middle tank. These arms are suspended from an overhead bearing and are rotated by hydraulic force when water is pumped through the circular column out through the arms and then through the nozzles which are set at an angle of 30 degrees to the vertical. Coal is fed into the first large tank at the point nearest "feed," and it passes between the baffle and the side of the tank to the bottom where it is agitated by water coming through the arms.

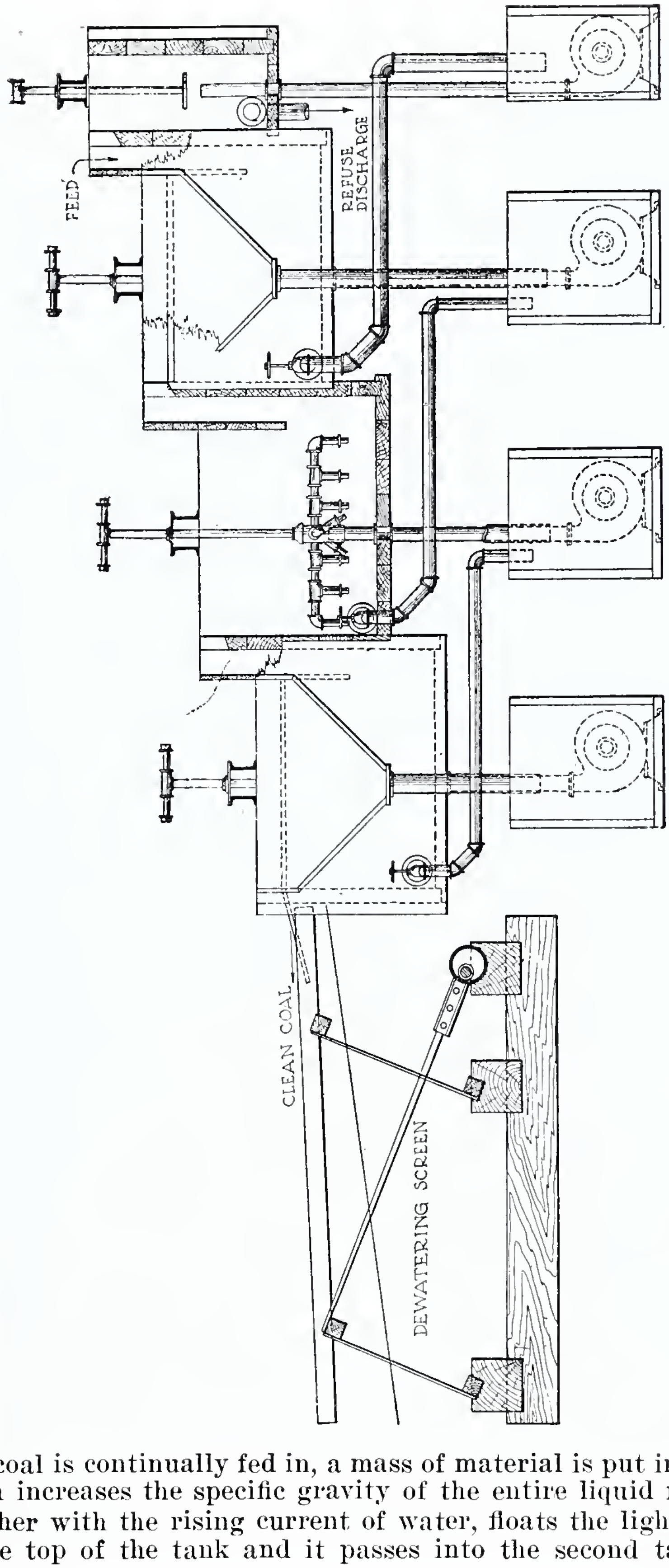


FIGURE 13
Hydrotator counter-current coal washing system.

If coal is continually fed in, a mass of material is put in suspension which increases the specific gravity of the entire liquid mass. This, together with the rising current of water, floats the lighter material to the top of the tank and it passes into the second tank. If the

heavy material were not drawn off the mass would tend to rise and flow over with the coal. A provision is made so that the quantity of material in suspension remains constant, and only the lighter material flows over.

The lighter material which flows over from the first tank passes between the baffle and the side of the tank to a second tank where a mass of material is again placed in suspension. The specific gravity is increased and the light material rises to the top and flows over into a third tank. Here again it passes between the baffle and the tank to the bottom where it is reagitated and the light material flows over to a dewatering screen. This screen may be either a Ferraris or vibratory type.

It is necessary to keep a constant quantity of material in suspension so that none of the heavy material will overflow with the coal. The proper specific gravity must be maintained. In order to do this it is necessary to continually draw out a certain quantity of heavy material. This is taken out of the bottom of the tank and is run to a sump tank under the second hydrotator tank. A certain quantity of water is added to it from an overflow from the top of the second tank and the mixture is pumped back into the second tank through the hydrotator arms which gives a chance to clean the refuse material from the bottom of the first tank. Some of the heavy material is drawn off and goes to a sump under the third tank. Here it is again diluted with water, pumped back through the arms in the third tank, and recleaned. The heavy material in the third tank is again drawn off and sent to a sump under a refuse tank which is immediately to the right of the third tank. From this sump the refuse is pumped up into the refuse tank but no rotating arms are used as the tank is very small. Any light material which may be mixed with the refuse floats to the top and passes over into the feed. The heavy material is drawn out through the bottom and sent to a refuse bank. In case it is desired to clean coal larger than 3/32 inch, additional tanks may be required, one for rice or 5/16—3/16 inch coal, and one for barley, 3/16—3/32 inch. There is no difference between the treatment of this coal and that finer in size, but the fine coal should be mixed with the coarse coal when the coarse coal is treated. After the coarse coal has been treated it is necessary to separate it from the fine coal by screening. If the coarse coal is not separated from the fine material when it is treated the coarse clean coal will settle with the fine refuse and is lost. In order to prevent this it is necessary to screen out the large clean coal.

The methods described for the treatment of coal by the hydrotator include sizes which will pass over a 65 mesh screen. When it is desired to treat coal which will pass through a 65 mesh screen, oil must be added in the last tank and the oil and air must be aspirated into the suction line of the circulating pump. This forms froth on top of the tank and the fine coal floats off onto the dewatering screen. This separation is due to the affinity of the oil and coal. There is no affinity between rock and oil. The rock or refuse settles to the bottom of the tank.

Hydro Separator. The hydro separator which is illustrated in Figure 14 is a simple machine which separates coal from slate or any other heavy impurities by a rising current of water which takes

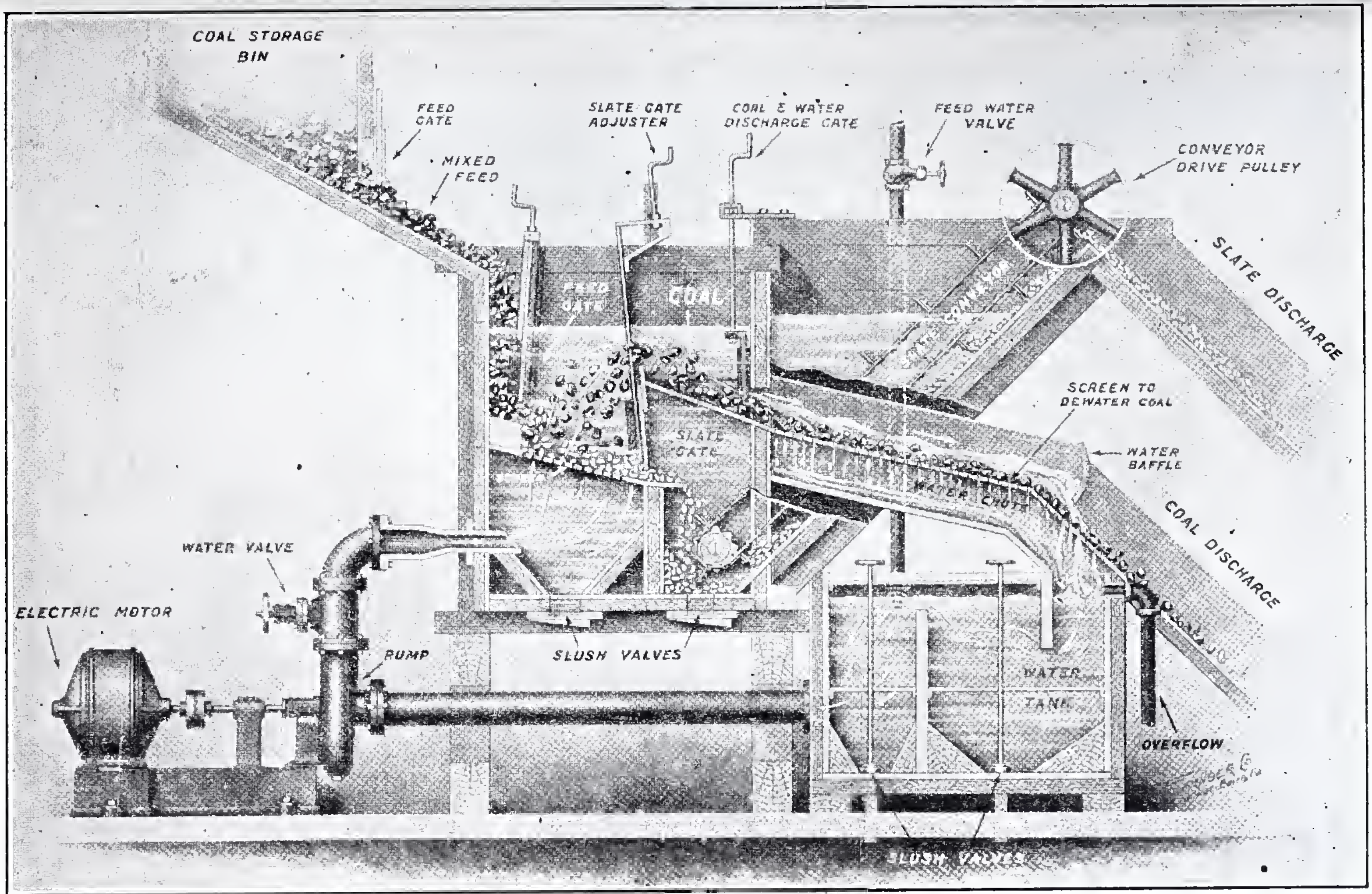


FIGURE 14
Sectional view showing assembly of hydro separator with motor pump and dewatering tank.

with it the pure coal and leaves the refuse behind to be automatically discharged from the separator.

The feed of mixed materials enters the machine from a bin and passes downward through a gate into a separating compartment where the rising current of water takes the pure coal over a wall into a water chute from where the coal is discharged to the dewatering screen. The slate and other heavy materials resist the upward current of water and form a loose mass of refuse which tends to rest on the perforated portion of the screen plate at the bottom of the tank. This refuse slides through a slit gate onto an unperforated portion of the screen plate. The pressure is applied by the loose moving mass of refuse behind it. The refuse passes through a slit gate and is picked up by a conveyor and removed from the machine.

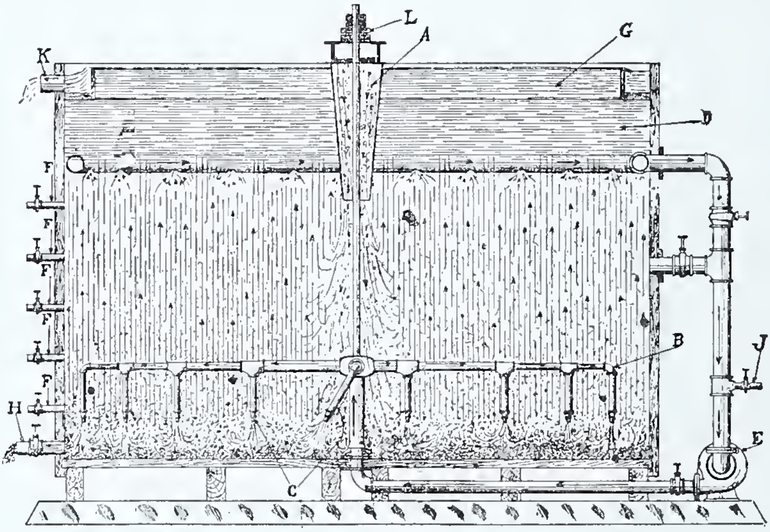
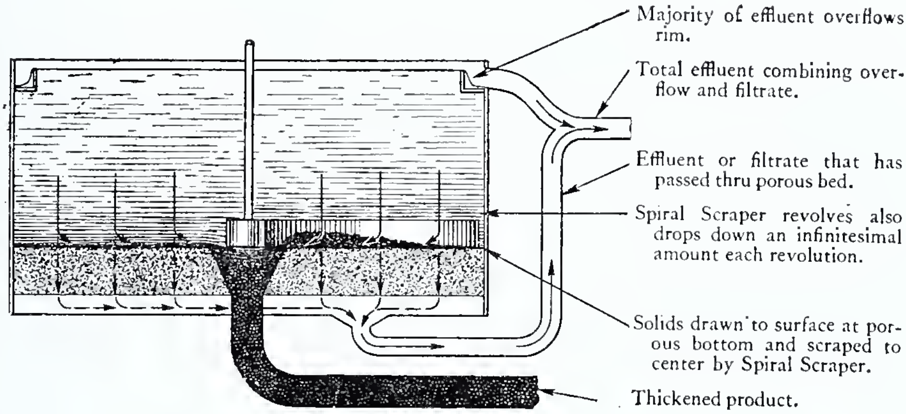


FIGURE 15
Hydraulic coal thickening, classifying and washing machine (Sectional view). Hydrotator Thickener.

This separator is very small compared to its capacity. Its weight empty is 2750 pounds. Its working weight is 44500 pounds. Its capacity varies from 15 to 30 tons per hour feed depending upon the size of the coal and the quality desired in the clean coal.

Hydrotator thickener. The regular hydrotator tank can be used as a thickener. The tank is divided into two zones. One, which is above the pump intake, is a quiet clear zone of water. Below the pump intake is the agitation zone where the thickness of the combined liquids and solids is limited only by the ability of the pump circulation to keep them in suspension. The finest solids rise to the level of the pump intake and are discharged on the bottom of the tank. Before they rise again to the intake level they must work their way through the thickened suspended solids above. The result is a maximum detention of the fine materials at the bottom of the tank farthest from the point where they would normally be found. Figure 15 illustrates the mechanism of this device.

Hardinge thickener. The Hardinge thickener is a tank with a domed grilled bottom on which lies a bed of sand, diatomaceous earth, or in some cases of the material to be thickened. The bed of sand or other material may retain its colloids if it possesses



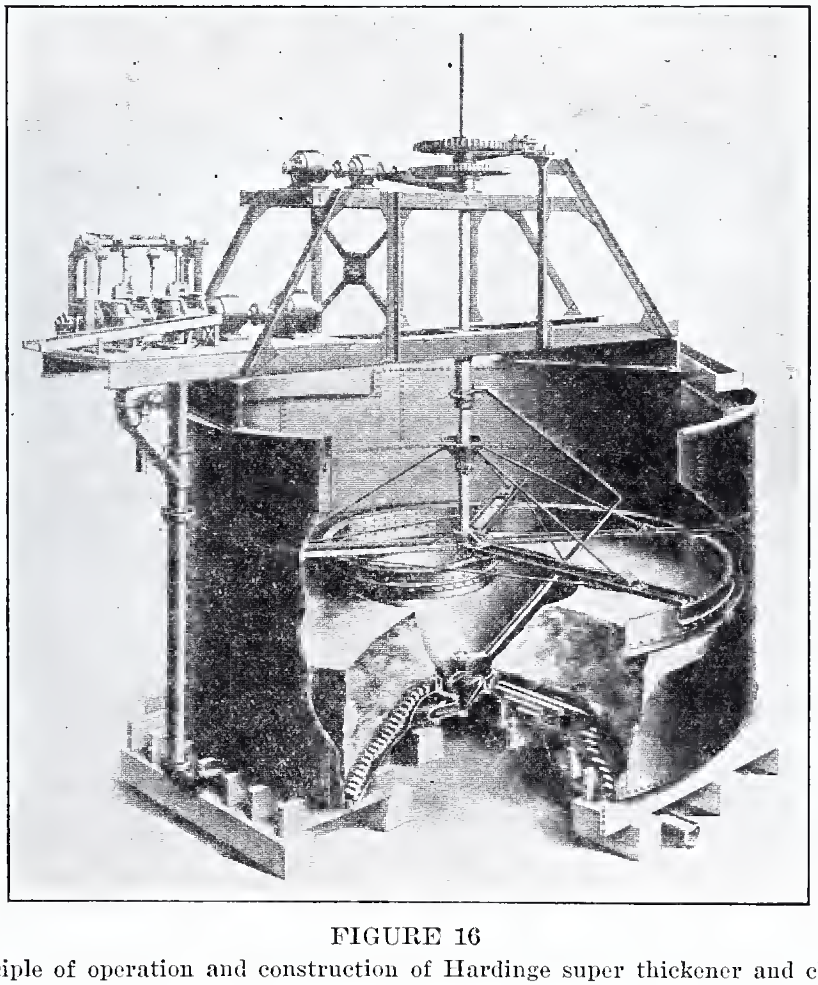


FIGURE 16

Principle of operation and construction of Hardinge super thickener and clarifier.

sufficient porosity. In the center, a well extends through this porous bed with an outlet at the bottom of the tank which is separate from the drain under the porous bed. A steel truss across the top

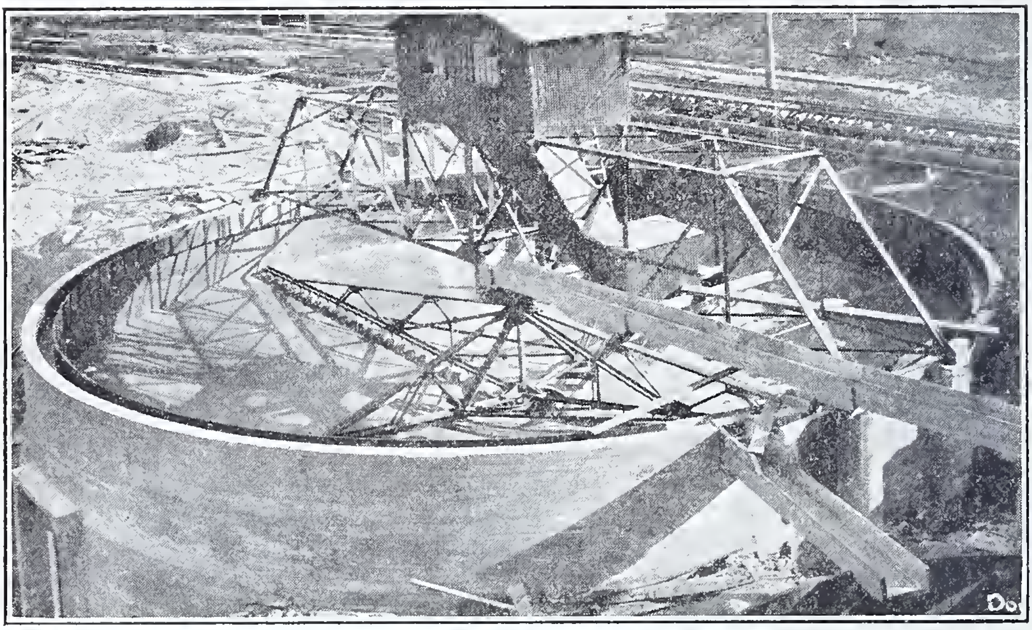
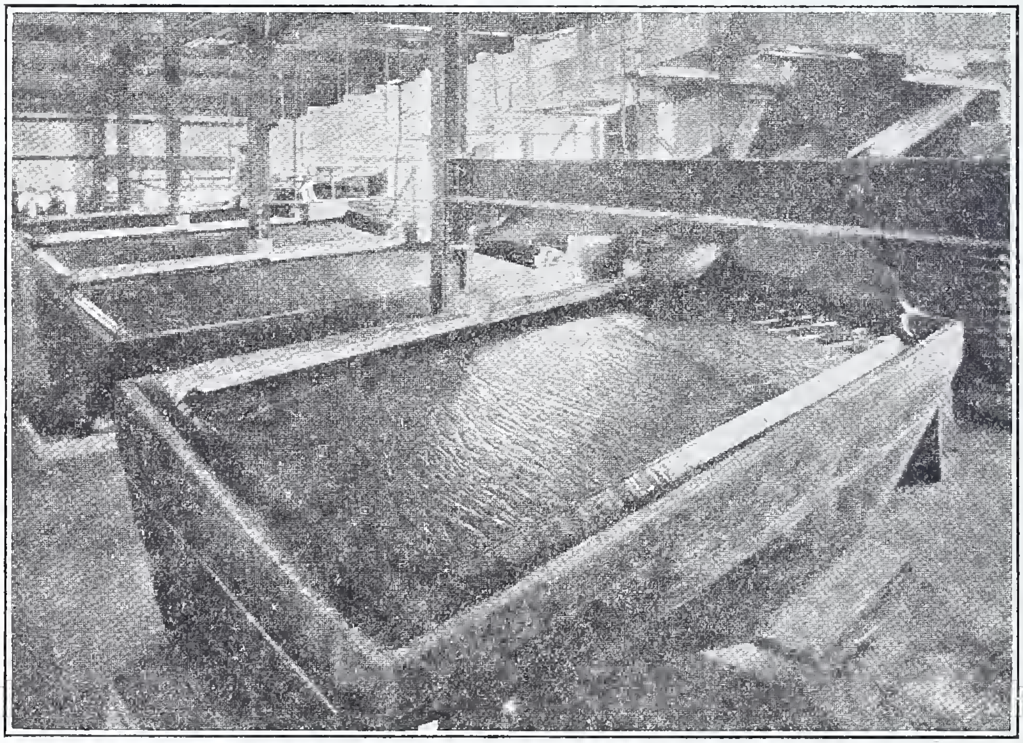


PLATE III
A. The Dorr thickener.



B. Four Deister-Overstrom tables on No. 4 buckwheat at Coaldale Colliery, handling underflow from Dorr hydroseparator.

of the tank carries a central vertical shaft suspended and operated from the truss. This shaft has a spiral scraper attached to its lower end. The shaft is threaded at the top and the feed is carried by the shoulder of a threaded spur gear screwed onto it. A worm driving-gear is keyed to the shaft below the threaded spur gear. As the spiral scraper revolves it scrapes the solids, which have filmed

over the surface of the porous bed, to the center well. The lowering is accompanied by a simple device which very slightly unscrews the threaded gear at each revolution and allows the whole mechanism to lower. This device can be regulated. The surface of the porous bed is thus kept clear and the constant rate of flow of filtrate is secured, with the spiral running continuously.

When it is operated as a thickener, with the main object that of dewatering the solids, the unthickened material flows into the tank at the center, to one side or through a box trough with the outlet near the bottom. Most of the clear liquid flows over the edge or effluent weir; part of it percolates through the porous bottom and is drawn off through the outlet and leaves the coal on the bottom. The particles which settle on top of the filter bed are slowly scraped to the discharge well at the center by the spiral scraper. The thickened or partially dewatered product is drawn off by pumps or decanted. The fine particles which settle on the porous filter bed would soon make this bed impervious without the spiral. The percolation of the liquid through the bed would first be reduced, then cease altogether. In order to prevent this, a minute film of filtrate is scraped away with each revolution. It has been found by experiment that the slimes or extremely fine particles that settle on the bed penetrate to a depth of one diameter of the average filter bed particle. It therefore takes only a small cut to keep the filter bed porous. The life of the bed depends upon the size of the grains of material of which it is composed.

The settling rate is increased by drawing part of the effluent through the bed. The slow setting or dense zones are drawn to the bed faster than the normal settling rate. All of these zones except those right at the surface of the bed should be of low density, which means that the particles suspended at the upper zones will settle much more rapidly than before. The product which is scraped into the center well can be made very thick, in fact, much thicker than if it is allowed to settle on an impervious bottom in the ordinary way.

It is possible to thicken some materials to 80 or 90 per cent solids. The overflow of the liquid may or may not be clear, depending upon the material which is being thickened. Any effluent which is passed through the filter bed is perfectly clear.

Dorr thickener. This hydro separator, as designed for separating coal, consists of a woodstave tank with an overflow launder around its edge at the top and a discharge outlet at the center of the bottom (See Figure 17). From a truss across this tank is suspended a central vertical shaft. On the bottom of this vertical shaft are mounted radial arms equipped with plows. By a slow rotation of the shaft the solids which settle out of the water are brought to the discharge opening at the center.

The slush is fed in at the center at the top of the tank. The area of the tank is proportioned to the average flow of the slush so that solids larger than 60 mesh fall to the bottom of the tank while most of those smaller than 60 mesh, together with the bulk of the water, overflow the edge of the tank. The overflow may either go to waste or can be clarified for reuse. In the anthracite fields the water is settled in a Dorr thickener. This thickener is identical

with the Hydro Separator with the exception that the area of the tank is enlarged. The settling velocity of the slush is so retarded that practically all the suspended material settles to the bottom and the water which overflows the edge of the tank is clear or slightly black.

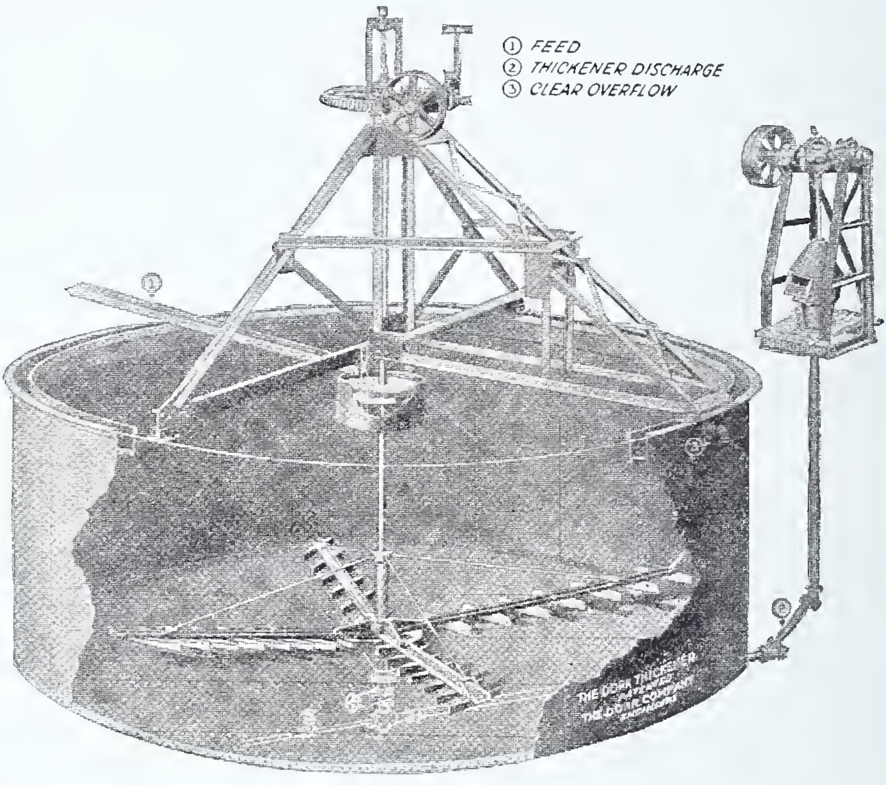


FIGURE 17

The Dorr Thickener.

Deister-Overstrom concentrating tables. The fine sized coal which is settled out of the water in the various thickeners, is cleaned by some companies. The cleaning is done on concentrating tables. Raw coal mixed with approximately twice its weight in water is delivered to the table through the feed box at the upper corner at the head motion of the deck. Water distributing boards are placed along the same side of the deck as the feed box to permit a fine adjustment in the distribution of water over the deck surface. The table is placed in a horizontal position and is practically level longitudinally, or level along its line of reciprocation. A slight side inclination at right angles to this line permits the clean coal to be washed over the long edge of the table to a trough or launder. This angle of inclination is adjustable. Simultaneously, the action of the head motion in reciprocating the deck, approximately 275 times per minute and with a stroke of $\frac{3}{4}$ inch, drives the pyrite and refuse which stratifies next to the surface of the table deck, over the short edge of the table where it is caught in launders and conveyed to the refuse heap. The riffles on the surface of the deck aid in collecting and guiding the refuse to its proper point of dis-

charge, and also prevent the finer particles of waste matter from washing over with the clean coal.

By extreme care in tabling and at a considerable sacrifice of capacity, fine sized coal can be reduced to 7 or 8 per cent ash. A medium sized table will effectively clean 3 to 4 tons of slush per hour. With the larger sizes 10 or 12 tons can be handled per hour.

Breakage

The breakage or degradation of anthracite begins inside the mine at the face. Anthracite, when mined, is often already crushed by severe stresses in folding and faulting. This natural condition is most prevalent in the Southern Field where the coal beds have been steeply folded and subjected to much crushing. A stope often runs thousands of tons of loose material before a shot is detonated in it. This material has a large percentage of steam sizes in it. The coal is sometimes ground to a fine powder.

Difficulties of mining, particularly in steep pitches, present problems in the production of a minimum quantity of fine sizes. Excess shooting and misplaced shot holes on the face cause unnecessary degradation. Weight of the roof on pillars insufficiently large for the load crushes them. The coal, particularly in steep pitch mining, is handled numerous times in the mine. Each time it is handled breakage occurs. Unnecessarily long drops of the coal cause degradation. The larger pieces hit upon each other and break. These factors pertain entirely to mining and are discussed in the chapter on mining methods. After the coal comes from the mine it is taken to the top of the breaker where the agglomerated mass starts in its preparation. The word "breaker" is a misnomer. The purpose of the breaker is to secure the largest quantity of domestic sizes of clean coal with the smallest quantity of breakage. A breaker is called upon to size coal to suit the demands of the trade. For instance, if a large order for nut coal is given, it is necessary to crush the larger sizes to produce a maximum quantity of nut coal and to eliminate as far as possible the production of smaller sizes. The first step is the screening out of the oversized coal which goes to the rolls for breaking into smaller size.

When the coal starts through the breaker on its course of preparation the first point at which breakage occurs is in the rolls. A roll must fracture or break the coal instead of crushing it. Some crushing, of course, is unavoidable. The increased percentage of crushing depends upon these conditions; the shape of the hopper on top of the rolls, the height of the drop where the coal strikes the roll upon entering, the spread of the roll, the quantity of coal fed into the roll, and the type of teeth. Coal should be dropped vertically into the roll and a short distance above it. The speed of the roll should be governed by the size of the coal to be broken. The feed of the material to the roll should be uniform. The type of teeth to be used should show the best breakage and fracture results.

After the coal leaves the roll it is carried to various parts of the breaker either by gravity or mechanical means. A large quantity of unnecessary breakage occurs in the older types of breakers. The new breakers are being built with the idea in mind to prevent, as

near as possible, all unnecessary breakage. Coal usually is distributed through chutes by gravity. These chutes differ in construction, material, shape and pitch. Chutes should be short and with as low as pitch as possible to convey the coal, in order to reduce friction as much as possible and to eliminate quick drops. A chute should be of such size that when the breaker is working at capacity the chutes would not be overloaded. The coal which comes into any chute should not be forced to strike the sides and runways. Coal must not drop from one chute to another, all possible friction should be avoided, and the coal should not strike upon other pieces while in transit. Degradation continues throughout the breaker and even occurs in the loading pockets and when the coal is loaded on the car for market.

It is not the purpose of this report to instruct the layman in the various methods of preparing anthracite for market. Anthracite breakers have been discussed in great detail in a number of publications. Enough has been described to give an idea of the manner in which anthracite is prepared for market.

USES OF ANTHRACITE SILT AND CULM

Introduction

Silt and culm accumulations are a result of economic conditions. Culm banks had their origin in market conditions. The dictates of the consumer necessitated the discarding of valuable coal. In the days when pea and chestnut coal were not used the larger sizes were comparatively cheap and the customer could see no benefit in using the smaller sizes. Chimneys in the older residences in the eastern cities were built to supply only the necessary draft for burning the larger sizes. If the householder desired to burn pea coal or buckwheat it was necessary to supply greater draft by installing blowers or by increasing the height of the chimney. Commercial plants could not see any benefit in installing special grates for burning the smaller steam sizes. As the price of anthracite increased, pea and nut coal became desirable as household fuel, and as commercial concerns saw that there is a saving in installing equipment for burning buckwheat sizes, these sizes established a place for themselves in the trade. Buckwheat gradually fought its way to the front until now it is one of the most desirable sizes for residential heating and for generating steam in factories. The Coxe stoker was invented with the idea of utilizing No. 2 buckwheat (rice). It not only did this but it has been found that No. 3 (barley) and No. 4 buckwheat (birdseye) can be burned on an automatic stoker with much success.

As coal decreases in size it becomes more difficult to find a use for it. Special equipment must be installed to clean and size it. This equipment takes up much more space than the equipment used in sizing and cleaning the domestic sizes, and the time consumed in preparation is longer. It is impossible, of course, to make small sizes pay for themselves. Nevertheless, any return which can be gotten from them reduces the burden on the larger sizes. Many companies are now mixing No. 2 and 3 buckwheat. These sizes can be burned very satisfactorily on automatic stokers. Even after a market has been found for the three buckwheats, over 10 per cent of the coal that is mined has yet to find a market. This material is carried away from the breaker in the wash water and is saved or allowed to go directly into the stream without settling. Only in the last few years have coal companies realized that this material is valuable. The use of this material is restricted. Much of it is used on mechanical stokers for generating power at the mines. Some of it is hand fired, but the labor item is too large to make this system of firing feasible. Some silt which has been cleaned is shipped to eastern points and is mixed with bituminous coal and fired by hand and by mechanical stokers under boilers in manufacturing plants. Some of the best silt is used alone on mechanical grates.

Producer gas can be made from fine sizes of anthracite. Some of the small producer gas plants in eastern Pennsylvania are fired with small-sized anthracite. Molds for certain types of metal castings are faced with a thin film of fine-sized anthracite. When the hot metal is poured into the mold the anthracite volatilizes and carbonizes quickly and gives a smooth surface to the casting.

The greatest market for anthracite silt is in the manufacture of briquets, anthracoal, and other types of prepared fuel and as powdered fuel. The briquet industry is now on a substantial basis and is growing from year to year. Large power plants have used powdered anthracite by itself or with bituminous coal in generating power. Good efficiencies have been obtained.

Public Service corporations in the anthracite region and in eastern Pennsylvania are using the fine sizes of anthracite on automatic stokers.

The use and disposition of old culm banks is not a serious problem. Many of them have been removed by leasing companies. The coal companies have not leased the best banks but are holding them in reserve for emergencies. Most of these banks could be worked over at a profit even during normal times. They are merely a supply of emergency fuel.

The enormous rock banks in the anthracite region have accumulated from breakers using the wet preparation of coal. These banks contain very small percentages of coal and they have no value except for crushing for mine filling. These banks will grow in size as dirtier beds are mined and as brushing the roof and bottom in thin beds increases. There is absolutely no way to remove or dispose of this material other than the methods which are now being practiced. The accumulation of waste material is the necessary evil of a basic industry to which the entire anthracite region owes its prosperity and existence.

Briquets

The American public, until 1922, did not take kindly to the briquet as a domestic fuel. The reason is obvious. Briquetting is not merely the operation of pressing together waste and inferior fuel with a smoky, sticky binder—it must necessarily be a careful, scientific operation, preceded by much thought and experimentation.

The first fuel briquets made in America were copied after those made in continental Europe and Ireland. In those countries people are not accustomed to high grade fuels. The coals briquetted there are generally of the lignite type—like the "brown coal" of Germany. In Ireland, peat is much used for briquetting. These primary fuels are high in ash and moisture, and the briquet is a satisfactory means of reducing these constituents.

The first briquets that appeared on the American markets were made of anthracite fines, bituminous slack, combinations of both, and river coal. They were pressed together by oily waste material, without regard to quantity or quality of that material. Needless to say, the briquets were not satisfactory, they gave off an offensive sticky smoke, disintegrated in storage and handling, lost their

shape in the fire, and because the material from which they were made contained large percentages of ash, they too were uneconomical fuels. The trustful public had been fooled, and the years following the war saw little demand for briquets, and "fly by night" companies gave up their efforts to market inferior and unsatisfactory fuel briquets.

During and since the war, large coal-producing companies, and companies specializing in coal preparation machinery, have spent many millions of dollars in concentrated effort to produce a briquet as satisfactory as the best raw fuel, and which could be sold at a price comparable to that which other fuels were bringing.

The results of the research have been slow, and many difficult problems have been met and solved. Six companies are now producing highly satisfactory briquets. Each plant represents a substantial investment. Scientifically constructed, rugged machinery is used. The binders for the fine sized fuel are carefully analyzed chemically; oil and by-product coke companies have spent large sums in producing a satisfactory binder. The results have met with success. The binder is no longer dumped, without consideration as to quantity, into the pulverized coal; a measured quantity is mixed thoroughly with the coal, so that the individual particles are coated and in a slight degree permeated with it. A good hard briquet with the characteristics of an ideal fuel has resulted.

Public prejudice against the briquet is gradually disappearing, and with the gradual increase in price of domestic anthracite, the demand for briquets is increasing. The briquet can now be manufactured to compete with the domestic sizes on the market. They are more satisfactory fuel than some grades of domestic sizes now being marketed. The fine coal from which the briquets are made, is cleaned, or "tabled," so that the ash content is 15 per cent or less. The binder is generally high in B. t. u. value, and raises the heating value of the briquet above that of most domestic sizes of anthracite.

Practically all the domestic furnaces in the anthracite-consuming territory of the United States are designed for the use of good, clean, large sized anthracite. The fire pots are too small to burn other fuel, or to burn small-sized anthracite economically and satisfactorily without forcing the furnace or adding additional draft with a blower. The briquet manufacturers have wisely experimented with the size, weight, and shape of the briquets to make a fuel which will behave well in the furnace under all conditions. The result is that most briquets are made in an egg or overstuffed pillow shape, and weigh from 1½ to 3 ounces. They have no sharp edges and corners to break off in handling, or break away from the briquet when it is heated.

A fuel which has been sized makes the prettiest fire. Most householders take pride in knowing how to fire their furnaces, and a pretty fire is a source of personal satisfaction to them. A good briquet makes a pretty fire, dull red when the draft is low, and bright red when the drafts are on full. The fuel briquet of today obeys its master, the draft—and does not lie dormant with an incandescent glow like those of yesterday.

In order to market the briquet on a large scale it will be necessary to advertise it, and educate the public in its use, just as the people of New England are being gradually educated to the use of low volatile bituminous coal. This advertising and education will cost much money, and until the domestic sizes of anthracite increase still further in price, no large quantity of briquets will be manufactured, because the industry is yet small and cannot expend large sums of money. Nevertheless, like all other infant industries, the manufacturing of briquets will grow from year to year, and gradually replace domestic sizes in the household bin.

The anthracite-consuming public is on the border years of great changes in use of fuels. As prepared anthracite becomes scarce and more costly, coke, sized and run of mine bituminous coal, residue of low temperature devolatilization of bituminous coal, fuel oil, briquets, and eventually manufactured gas will gradually become popular. Even today some of these fuels are in much demand.

History. The coal briquet probably originated near the Belgian-German border in the early part of the last century. From there its manufacture spread to France, England, Scotland, Ireland, and finally to America.

The brown coal of continential Europe is very bulky, and does not stand transportation well. This lignite or brown coal constitutes a little less than half of the coal production of Germany. In mining or stripping it, large percentages of fines are produced. Much of this fine-sized coal is briquetted; approximately one-third of the total production. The lignite contains 25 to 50 per cent moisture, and its heating value is as low as 2,000 calories, or 3,600 B. t. u. Briquetting drives off much of this moisture, and makes a more compact fuel, suitable for transportation to some distance.

The first use of briquets in Europe was for locomotive fuel. More briquets can be carried in the tender than lignite. The briquets vary in size and shape, but most of them are pressed into shapes which approximate the size and shape of American paving brick or cobble stone. These briquets are piled neatly by hand in the tenders of the locomotives, and make a convenient form of fuel.

In domestic use they are either burned whole or broken up. Many tons are burned in fireplaces and in cooking stoves. They give a slow steady heat, and are a fairly desirable fuel, except that they are somewhat smoky.

In Ireland, peat is being briquetted by pressure alone. In place of the bulky, smoky dried peat, a much consolidated product, hard, and with a shiny surface has been obtained. The moisture in a good peat briquet is less than 5 per cent.

In England and Scotland fine-sized anthracite and bituminous coal are briquetted into “boulets”. These briquets have found their way into domestic and manufacturing uses.

In Europe the briquet is a large factor in the coal industry. The people of continential Europe in particular are not accustomed to high grade fuels. The briquet, although not as good as the American made briquet, is satisfactory for their uses.

The American public, particularly that of the anthracite-consuming territory, has become accustomed to using a smokeless fuel, which is readily responsive to draft, is clean, and easy to fire. They have become most exacting in their demands for fuel.

The first venture in the manufacture of briquets in America was not successful, neither were many other trials. The product could not meet the competition of anthracite, principally because it was smoky and the briquets would not stand up under transportation and heat. From 1870 to 1915 there were approximately a dozen attempts to market a briquet made from anthracite fines. These plants operated for a few months a year and finally were dismantled.

The first record of the manufacture of briquets in the United States was in 1872; E. F. Loiseau briquetted yard screenings and anthracite at Port Richmond piers, Philadelphia. The binder was clay and the briquets were shellacked to make them waterproof.

In 1876 the Delaware & Hudson Company began operating a plant at Rondout, New York. Anthracite fines were bound with a gas tar. This plant operated for four years. The briquets were made for engine fuel. They were not satisfactory because the fumes corroded the boiler flues. In 1878 E. F. Loiseau constructed a briquet plant at Nesquehoning, and used pitch for binder. The product was so expensive that it could not compete with freshly mined anthracite. The Philadelphia & Reading R. R. constructed a briquet plant at Mahanoy City in 1890. The binder was English coal tar pitch. The original briquets weighed 18 pounds; but the later product weighed 2 pounds. Unfavorable conditions of various kinds forced the abandonment of the project.

In 1904 the Zwoyer Brothers erected a plant in Jersey City. This plant was afterwards moved to Brooklyn and to Perth Amboy. Anthracite culm from the Lykens Valley District was bound together with coal tar pitch. The plant operated intermittently until it was destroyed by fire in 1909. The property was sold in 1911.

The Scranton Anthracite Briquet Company's plant was built at Dickson City in 1906, and operated almost continuously until 1924. Anthracite silt was bound together with pitch. The briquets were 2 ounces in weight and pillow-shaped. The pitch binder was not entirely satisfactory and a change was made to asphalt.

In 1909 the Coal Compress Company established a plant in West Philadelphia. The Giles binder was used. It consists of a hot paste prepared from common flour and water and carried in solution by hot iron sulphate. The sulphate is supposed to impart a hard surface to the briquet. High cost of production was fatal to this operation.

The Eggette Coal Company of Trenton, New Jersey, established a plant in 1912 and used the Giles binder. This plant went through a varied existance and in 1916 was entirely remodelled. Sulphite liquor binder was substituted for the Giles binder.

The American Coalette Company established a plant in Philadelphia in 1913. This plant used hydrolene for binder and produced a very satisfactory product. It continued in operation until 1917. The Gamble Fuel Company established a plant in Harrisburg, Pennsylvania, in 1916. The plant was designed to use the Gamble patented binder which consisted of sulphite liquor partially waterproofed

by oil admixture. River coal dredged from the Susquehanna was the basis of the product. The briquets were not of good quality and the company disbanded in 1919.

The American Briquet Company in 1917 established an experimental plant in Philadelphia. In the following year the company built a large plant at Lykens, Pennsylvania. The Hite binder is being used at this plant. The plant burned down and a large modern plant is now manufacturing briquets at this locality.

The plant of the Lehigh Coal & Navigation Company at Lansford is now abandoned and a new experimental plant has been constructed in Perth Amboy, New Jersey.

In 1920 the Burnite Coal Briquetting Company established a plant at Newark, New Jersey. The binder used is secret. The coal is shipped from the anthracite region and is compressed in pillow-shaped briquets weighing 2 ounces.

The most active of the briquet plants are described later in this chapter.

During the European war the coal industry and all other industries depending upon it were in a very abnormal period. Coal prices increased threefold and many unscrupulous producers and dealers unloaded inferior fuel upon the public. Thousands of tons of coal was shipped from reworked anthracite culm banks. Some of this fuel found its way into the briquetting industry which was able, under the unusual conditions to market this prepared fuel. Needless to say these briquets, which were made very hastily and without proper consideration of methods of manufacture, could only be sold in anthracite-consuming territories when anthracite was scarce and selling at a premium. After the war these companies disbanded and for a few years the making of anthracite briquets practically ceased. When the coal industry had again stabilized itself after the war numerous anthracite companies undertook seriously to produce a briquet that would be absolutely satisfactory in all its physical and chemical characteristics. They have refused to put on the market a briquet which will not compare favorably with corresponding domestic sizes. Some fairly satisfactory anthracite briquets had been made prior to the anthracite strike of 1922-1923. During that period the public became acquainted with the possibilities of this fuel and the infant briquetting industry found a firm foundation for its future life. Since that time experiment has continued and at the proper time several anthracite companies will be able to put on the market an entirely satisfactory briquet.

Seven companies are now producing briquets on a commercial or semi-commercial basis. Possibly the most successful plant is at Lykens, Pennsylvania. This installation will be discussed under a later heading.

*Statistics of production.** The value of fuel briquets manufactured in 1925 was $7,128,404. Of this amount $1,842,257 worth of briquets were produced in the Eastern States. Practically all of these briquets used anthracite.

Fuel briquets produced in the United States, 1907-1925.

Year	Net tons	Value	Year	Net tons	Value
1907	66,524	$ 258,426	1917	406,856	2,233,888
1908	90,358	323,057	1918	477,235	3,212,793
1909	139,661	452,697	1919	295,734	2,301,054
1910	(a)	(a)	1920	567,192	4,623,831
1911	218,443	808,721	1921	398,949	3,632,301
1912	220,064	952,261	1922	619,425	5,444,926
1913	181,859	1,007,327	1923	696,810	5,898,698
1914	250,635	1,154,678	1924	580,470	4,986,622
1915	221,537	1,035,716	1925	839,370	7,128,404
1916	295,155	1,445,662			

(a) No canvass for 1910.

Average value per net ton (f. o. b. plant) of briquets produced in Pennsylvania and in the Central States, 1911-1925.

Year	Pennsylvania	Central States	Year	Pennsylvania	Central States
1911	$ 2.37	$ 4.34	1919	4.17	8.47
1912	2.68	4.47	1920	5.60	9.23
1913	2.65	4.92	1921	6.14	9.28
1914	2.48	4.83	1922	5.93	9.02
1915	2.90	4.26	1923	5.95	9.35
1916	3.83	4.73	1924	5.82	9.00
1917	3.15	6.81	1925	6.35	8.72
1918	4.11	8.17			

Raw fuels used in making briquets in the United States, 1921-1925, in net tons.

Fuel	1921	1922	1923	1924	1925
Anthracite culm and fine sizes and semianthracite	190,964	254,563	331,102	224,539	387,454
Semibituminous and bituminous slack, coke and semicoke[1]	121,925	235,542	225,508	297,814	341,161
Subbituminous coal and oil-gas residue	85,352	123,339	125,880	61,012[2]	115,975
	398,241	613,444	682,490	583,365	844,590

[1]Includes no semicoke, 1921 to 1924, and no coke, 1923 to 1925.
[2]Includes no subbituminous coal.

*Mineral Resources of the United States, Fuel Briquets in 1925, James E. Black. U. S. Bureau of Mines 1926.

Briquets are used almost exclusively for domestic purposes in the United States. The demand is seasonal and depends upon climatic and market conditions. When other fuels are scarce the production of briquets increases.

Monthly production of fuel briquets in the United States in 1925, in net tons.

January	93,310	August	63,161
February	62,479	September	79,118
March	47,504	October	118,543
April	26 498	November	123,316
May	26,350	December	128,684
June	28,183		
July	42,224		839,370

"Recent reports of the Bureau of Mines, Department of Commerce, Washington, D. C., indicate a sharp increase in both quantity and value of product characterized the fuel briquet industry in 1926. According to figures courteously furnished by the operators, the production in 1926 was 995,332 tons, an increase over 1925 of 19 percent. In comparison with 1923, the increase is 43 per cent.

"The largest single cause of the increase was undoubtedly the great strike of the anthracite miners which began September 1, 1925, and was not settled until February 12, 1926. The strike served to introduce briquets to some thousands of consumers who had not tried them before, but it is clear that the growth of the briquetting industry does not rest alone on such interruptions in the supply of anthracite. The production has been growing ever since 1907, when the first statistical survey showed a total of only 66,524 tons. The periodic shortages of fresh-mined anthracite have merely served to stimulate what would otherwise have been a fairly steady increase. That the briquetting industry is likely to hold some of the ground gained in 1926 is shown by the fact that the largest output in the year was reached in November and December, by which time the anthracite shortage had been entirely overcome.

Fuel briquets produced in the United States, 1925-1926

	1925		1926	
	Net tons	Value	Net tons	Value
Eastern States	253,643	$1,842,257	288,884	$2,110,932
Central States	422,411	3,684,095	575,130	5,093,062
Pacific Coast States	163,316	1,602,052	131,318	1,329,185
	839,370	7,128,404	995,332	8,533,179

"The trend of prices of fuel briquets from year to year is best indicated by the average value in particular localities, as shown in the table below. The average value f. o. b. producer's plant for the State of Pennsylvania in 1926 was $6.74, an increase of $.39 over 1925 and $.92 over 1924. The average value for the Central States, in which the plants at the head of Lake Superior are the largest element, was $8.86 a ton, as against $8.72 in 1925 and $9.00 in 1924.

Average value per net ton (f. o. b. plant) of briquets produced in Pennsylvania and in the Central States, 1919-1926.

Year	Penn'a	Central States	Year	Penn'a	Central States
1919	$ 4.17	$ 8.47	1923	$ 5.95	$ 9.35
1920	5.60	9,23	1924	5.82	9.00
1921	6.14	9.28	1925	6.35	8.72
1922	5.93	9.02	1926	6.74	8.86

"The total quantity of raw fuel used in 1926 was 971,135 tons. Of this, 44 per cent was anthracite and semi-anthracite; 47 per cent was semi-bituminous and bituminous coal and semi-coke; and 9 per cent was sub-bituminous (black lignite) and carbon residue from the manufacture of oil gas.

"Eighteen plants were in operation in 1926. All plants that were active in 1925 continued to produce and in addition the new plant of the Empire Collieries Co., at Pulaski, Virginia, began operating on March 1, 1926. Another new producer, the Salem Briquette Company at Salem, Mass., has since begun operation, but produced no briquets in 1926.

"The average production per plant in 1926 was 55,296 tons. Three plants produced less than 2,000 tons and three others more than 100,000 tons. The total capacity of the 18 plants per 8-hour shifts was 4,151 tons. Several of the plants, however, work more than one shift, and in the busy season the actual production per day of 24 hours has exceeded 7,000 tons."

Physical and chemical characteristics of a good briquet. To be successful a briquet must have a close approximation of the physical and chemical character of a good grade anthracite stove coal.

The first demand upon a briquet is that it be smokeless. If anthracite is used this smokeless character depends entirely upon the binder. Coal-tar products, when used as a binder, do not give a smokeless briquet. The most satisfactory binder is asphalt pitch, known commercially under various names, including hydrolene. Some companies have used other cementing materials in addition to asphaltic pitch, but asphaltic pitch has been the basis of the binder in all satisfactory briquets, except those which are partially or wholly carbonized to hold them together.

A briquet should have the proper hardness and toughness. It must be sufficiently hard to withstand transportation and handling without much degradation. A satisfactory briquet should not degradate more than 5 per cent of its total volume. If the briquet is too hard it is brittle and fractures when it is handled; if it is too soft it breaks down and rubs off when it is handled. A briquet can be made harder by using a binder of high melting or softening point. A melting point in excess of 160° F. is high. When a binder having a melting point less than 160° F. is used it is likely that the briquet will disintegrate in handling and under pressure. A briquet should not soften under 140° F.

The briquet should have approximately the same density as the material from which it is made. In the case of anthracite the density would range from 1.1 to 1.4. The density of a briquet can be varied by pressure.

A briquet should be of satisfactory size. The manufacturers of domestic heating apparatus for sale in the anthracite-consuming territories rate their boilers on stove coal. The combustion space of these boilers is determined very carefully. When sizes other than stove are used the efficiency of the boiler is impaired unless additional draft is introduced. Additional draft often impairs the efficiency of furnaces by too rapid combustion with the consequent escape of CO up the stack. Of course, the author does not desire to leave the impression that fine-sized anthracite cannot be used in a domestic furnace with success, for very desirable results have been obtained by thousands of users by mixing buckwheat sizes with proper proportions of domestic sizes. But this mixture should be made from separate bins and the coal fired in alternating layers in proper proportion. The percentage of each size fired is governed by weather conditions.

A briquet should then have approximately the same size and weight as one of the domestic sizes. Large briquets are popular abroad but they must be broken before they can be used in a domestic furnace. In America the consumer is too busy to break the briquets. They must then weigh from $1\frac{1}{2}$ to 3 ounces.

The shape of a briquet has much to do with its success. If the briquet has sharp edges, these break off in handling, causing loss of coal and increasing the dirt in the coal bin. If the briquet is round it does not ignite readily. It is necessary then to press the briquets in a form which lacks sharp edges and corners but yet presents fairly thin surfaces to the flame by which the briguet is to be ignited. Briquets having the shape of an overstuffed pillow or pin cushion are very satisfactory; oval or egg-shaped briquets are also manufactured. Pillow-shaped briquets with their edges rounded is also a satisfactory shape. Although the rounded edges cause less dust and breakage and insure good air circulation and thorough combustion they are wasteful in space, and if the briquet is particularly dense they may be hard to ignite. A ton of pillow-shaped briquets occupies a larger volume than a corresponding size of domestic anthracite.

Briquets must ignite readily but have the properties of withstanding combustion for a long time, preferably in the neighborhood of six hours in the ordinary domestic furnace. This characteristic depends upon the density of the briquet and the quantity of volatile matter in it.

A briquet must hold its shape under intense heat. Briquets made with coal-tar binder are more likely to flow than those made with an asphaltic base binder. Sulphite liquor and starch products hold up well under extreme temperatures. It is almost impossible to manufacture a briquet with a binder which does not soften when the more volatile parts of the binder are being burned. Later on in the period of combustion the briquet is carbonized and becomes extremely hard. The burning characteristics of briquets are discussed farther on in the text.

The briquet must readily lend itself to variations in draft. When a slow fire is desired the briquet should burn slowly with the emission of moderate heat. When a hot fire is desired the briquet should burn fast with the addition of more draft. A briquet should not absorb more than 3 per cent moisture. The quantity of absorption increases with a decrease in density. Some binders absorb water.

Burning qualities. An anthracite briquet should ignite easily and burn for a long time under ordinary draft. The flame of a briquet should be clear and intense bluish yellow, and should burn without odor or smoke. Combustion must be complete. In the ordinary household furnace the ash contains from 20 to 40 per cent and often 50 per cent carbon. A satisfactory briquet, fired in the proper manner, leaves from 5 to 15 per cent carbon in the ash. A briquet should not clinker or flow together; in fact, any properly made briquet does not clinker. Here again the question of shape is also very important. If a briquet breaks down under intensive heat or combustion the finer particles obstruct the passage of air through the fire pot and a sluggish fire results.

Of course the briquet must have the proper chemical character. If the briquet is manufactured to compete on the market with domestic sizes it is absolutely necessary to preserve good quality in it. The ash should not be more than 15 per cent, which is under that of most of the domestic sizes now on the market. The ash from briquet, is of course the sum of that contained in the coal and in the binder. Organic binders contain a smaller percentage of ash than the slack coal and therefore decrease the total ash content of the briquet; on the other hand, inorganic binders often add to the percentage of ash.

Binders. The selection of a binder to use in briquetting is governed by many factors, the principal of which are:

(1) Character of the material used in briquetting.
(2) Purpose to which the briquet is to be put.
(3) Geographic location of the manufacturing plant.
(4) Availability of binding material.

Numerous binders have been used for briquetting in the United States. Briquets have been made successfully without binders with the admixture of small quantities of bituminous coal. The mixture is pressed together and carbonized so that the bituminous coal acts as the binding agent.

The various binders will be described separately.

Asphaltic pitch is the most popular binder used in briquetting anthracite. It is the heavy residuum from oil distillation plants, popularly known as asphalt. Because of its cheapness and easy accessibility in the Eastern States it is a practical binder. Its cost ranges from a few cents to $1.00 a ton of manufactured briquets, depending entirely upon the type of briquet.

Small percentages of this binder satisfactorily bind anthracite fines together. From 4 to 6 per cent is all that is generally used. Since the sale of this binder has increased it has become economically possible to treat the raw asphalt residuum so that a binder is produced with strong bond and a minimum of smoke and oder. The binder assures a high percentage of purity and high waterproofing value. It produces a hard briquet that will withstand handling in transportation and remain intact until completely burned. The asphalt pitch is higher in heating value that the coal itself. It generally contains more than 18,000 B. t. u. per pound. The material is made at a consistency of approximately 160° F. melting point, which has been established as the proper one. It gives the proper ignition point to the fuel and holds the briquet together until carbonization of the binder has progressed to the proper point.

There are other products of the petroleum industry which could be used in part or whole for binders.

In the manufacture of water gas, petroleum is used in enriching the product. The oil is partly decomposed in the process and a by-product, water gas tar, is produced. This product has a density of 1.1. The water gas tar is viscous and could not be used alone. However, a satisfactory pitch can be made from it. Experiment has shown that 5 per cent of this pitch is sufficient to produce excellent briquets.

A substance known as Pittsburgh flux is made by heating oil with sulphur. It melts at 195° and makes a satisfactory briquet when about 8 per cent is added.

Natural asphalts of local occurrence could be used as binders. The principal natural asphalts are impsonite, albertite, gilsonite, and maltha. These natural asphalts occur principally in the Western States, and are the basic materials left behind in oil seepages. The quantity of these asphalts necessary to use in making satisfactory briquets would of course vary with the nature of the material. Some of the materials are more viscous than others. The commercial aspects of these natural asphalts would be governed entirely by their geographic location. They would not play a role as binders for anthracite briquets because they are too far from the source of this fuel.

Tars and pitches from coal are another large source of binding materials. Many companies have used these materials with varying success. In the main these products do not make a smokeless binder. They are cheap, however, and their quantity is increasing yearly with the installation of more and more by-product coke ovens. None of the oils coming off below 270° C. are useful in briqueting. The flowing point of the pitch to be used as a binder should not be less than 70° C. Pitch has no true melting point. It is a mixture of various chemical fractions, each of which has its own melting point. Coal-tar pitches are not usually worked as binders. The pitch must either be so brittle it can be broken into fine particles and mixed with the coal as a solid, or it must be heated to approximately 100° C. and mixed with the coal as a liquid. Therefore, coal-tar pitch must be adapted to the particular type of briquetting machinery which is being used.

The flowing point of coal tar is very important in determining its use as a binder. The higher the flowing point of the pitch the more satisfactory binder it makes up to a certain point. If the pitch has too high flowing point it can be softened by the addition of a pitch or tar having a lower flowing temperature.

Blast furance tar, gas tar, coal tar, creosote, illuminating gas tar, and by-product coke oven tar are possible briquet binders. The latter tar is now being produced in large quantities, and no doubt a satisfactory binder can be made out of it. The tar is obtained by distillation at high temperatures and therefore contains a greater percentage of carbon than the other tars. The principal objection to coke oven tar is that it is too liquid to be used alone as a binder. Unless it is properly mixed with other materials it will probably produce an offensive smoke.

Cornstarch has been used with varying success as a binder. It has excellent adhesive qualities and makes a good, tough briquet, but it is not waterproof. The cost of the material is also high. Cornstarch will be used only as a binder for briquets in which waterproof qualities are not desired, and as a material to be mixed in proper proportions with other materials such as oils, tars, and asphalt residues.

Sulphite liquor is a by-product of wood pulp mills. In the manufacture of paper, wood pulp is treated with sulphurous acid to remove the lignone groups. These groups combine with the sulphurous acid and are removed in the waste water. This liquor, which is produced in large quantities, is worse than just a waste product.

It enters the streams and kills the life in them. In recent years numerous attempts have been made in the use of sulphite liquor for binding various materials together. Its cohesive property is large. In the manufacture of briquets where the waterproofing quality is not essential, sulphite liquor is a good binder, because it is cheap and only small percentages of it are necessary to bind particles of coal together. Briquets in which sulphite liquor is used as a binder can be partially water proofed by the addition of various percentages of asphalt residues and coal tar. A very good briquet can be produced with sulphite liquor alone if the briquet is subjected to heat and the sulphite liquor is carbonized to the maximum point above which the sulphite liquor would lose its cohesiveness.

Some engineers have claimed that the only objection to the use of sulphite liquor, other than it is not waterproof, is that excessive quantities of sulphur fumes are generated which deteriorate furnace linings and tubes. The author does not believe, however, that the small percentage of the sulphite liquor which it is necessary to use in briquetting would add enough sulphurous vapor to injure the metal parts of a furnace.

Other organic binders such as rosin, pitch, and pine wood tar could be used in various quantities for binding coal, but these materials are relatively expensive and their usefulness would be localized.

Another large group of binders is inorganic. Fairly satisfactory briquets can be made with these materials as a binder but all of them increase the ash content of the manufactured product. All of the inorganic binders are non-volatile so that briquets made from any type of coal will stand in the fire without breaking down. Inorganic binders slow down the combustion of the briquets which, in a way, is desirable, because it means more complete combustion with the emission of less smoke. Another advantage in the use of inorganic binders is that the bulk of the calcium, sodium, and magnesium salts unites with the sulphur from the coal and minimizes the emission of odorous and oxidizing products.

Clay, lime, and magnesia may be possible binders if they are mixed with other materials. In 1880 Dr. A. Gurlt recommended a binder composed of 30 parts of 45 per cent magnesium chloride, 30 parts of 93 per cent magnesium oxide, and 60 parts of water. This material made a very satisfactory briquet with only 3 per cent addition of the magnesia cement. It, however, added 2½ per cent to the ash content of the briquet.

Plaster of Paris and Portland cement make satisfactory briquets if a low ash content is not desirable. Experiments by the U. S. Bureau of Mines have shown that it takes 12 per cent of these materials to make a satisfactory briquet.

The U. S. Bureau of Mines Northwest Experiment Station at Seattle, Washington, has been experimenting with a binder which was an accidental discovery by a Washington man named Sheehan. This binder consists of a mixture of native sulphur and asphalt. There is one vital fault with this binder that has prevented its commercial exploitation. It is a trifle too expensive. With the exception of this one difficulty the mixture of native sulphur and asphalt is an excellant binder. Evidence shows that it will serve as a binder

for any rank of coal from lignite to anthracite. A partially burned lignite briquet when pulled from the fire and quenched possesses all the structural properties of a rather poorly cohered piece of coke. The presence of sulphur with the asphalt also in a large measure prevents the distillation of the asphalt during the burning of the briquets and thereby lessens one of the chief objections to that binder, the soot nuisance. Apparently the sulphur acts only on the binder and not on the coal itself in producing these two effects. The Bureau of Mines has been attempting to determine the function of the sulphur and to replace it with a different and cheaper substance or perhaps accomplish its physical or chemical action by some other means.

A binder called cohesite is now on the market. It is of English origin and is an emulsified asphalt.

The American Briquet Company controls the Hite binder. It is a combination of two methods for waterprofing starch binder, namely by adding asphalt and heating. Twenty-five gallons of water is mixed with 140 pounds of Globe pearl starch. This mixture drops slowly into 175 gallons of boiling water which is being thoroughly agitated. The mix thickens into a starch paste and 35 gallons of melted asphalt at a temperature of 220° F. is added to it. The addition is made very slowly to secure proper emulsification. When the emulsification is complete, the binder is ready for use. It is composed of 79 per cent water, 6 per cent starch, and 15 per cent asphalt.

The American Cyanamid Company of New York believes that natural and compounded adhesives made from carbohydrates are the most effective, cheapest, and more abundant binding materials. This series of water-soluble binding compounds requires sufficient drying and heating to convert them by carbonization into water-insoluble binders. Baking briquets made with carbohydrate binders has proved to be commercially impracticable because of the narrow temperature limits. When baked below the limit the briquets are hard but the binder remains water-soluble. When baked above the temperature range the briquets, though water-insoluble, are too fragile for domestic or industrial use. After much experimenting a solution of the problem has been reached. Phosphoric acid acts both as a dehydrating and a fireproofing agent. When phosphoric acid is mixed in proper proportion with various carbohydrate adhesives a lower baking temperature with a much wider heat range can be used to carbonize the binding material. The finished briquets are water-insoluble, have an increased hardness, and are entirely free from acid. The oxidization temperature of the ultimate binder is equal to or slightly higher than that of the coal which is briquetted. This oxidization temperature depends upon the quantity of the acid used. As a result of the chemical and physical properties imparted by phosphoric acid, satisfactory binding compounds have been developed. From natural adhesives such as concentrated sulphite liquor and evaporated molasses residue, compounded carbohydrate adhesives of dextrinized starch paste can be produced from low grade, spoiled or waste flour, cheap starches, and inferior grain. The briquets made from this binder material can be cured at temperatures not exceeding 500°F. The baking process can be carried on effectively in continuous ovens.

Chemical and physical characters of a satisfactory binder. A binder of course must be cheap enough to make it possible to manufacture briquets at a profit. The binder must be cohesive enough to make a hard briquet which will not fracture easily. It should hold the briquet together in the fire until combustion is complete. In climates where there is much rainfall and the air is humid, it is necessary to use a binder which will waterproof the briquet if the briquet is to be handled to any great extent. A good binder decreases rather than increases the ash content of a briquet. The coal which is used in the briquet, principally anthracite fines, could not stand an addition to ash; rather it is desirable to use a binder which will reduce the ash content. A binder should not cause the briquet to clinker or emit smoke or other obnoxious gases. It should not deposit soot or tar on the metal parts of the furnace. A good binder increases rather than decreases the heating value of a briquet.

Briquetting Plants

American Briquet Company. Of the seven plants using anthracite for briquetting, four are located in Pennsylvania. The largest manufacturer of anthracite briquets in the State is the American Briquet Co. The plant is located at Lykens, Pa., in the Lykens Valley coal field. This company is operating a plant designed by their own engineers. They are using a very satisfactory binder which is their own patent. This company has been very successful in the manufacture and marketing of briquets. They are using a silt bank composed of fine-sized coal settled from breaker water from Short Mountain colliery of the Susquehanna Collieries Company. This bank is exceptionally low in ash and makes an excellent material to briquet. Detailed information concerning the quality of briquets made from this bank is as follows:

Analyses of briquets, as received, made by American Briquet Company, Lykens

Date 1927	Moisture	Volatile matter	Fixed carbon	Ash
March 7	.7	12.5	77.8	9.0
8	.7	11.7	78.7	8.9
9	.7	11.9	77.4	10.0
10	.6	12.2	77.6	9.6
11	.7	11.8	78.6	8.9
12	.6	11.7	79.3	8.4

A description of the plant is as follows:

The coal is conveyed from the bank to the storage bin by a Sauerman slackline cable. The bucket has a capacity of 93 cubic feet. The coal is fed to the rotary driers from the 600 ton storage bins by apron feeders. The rotary driers have sufficient capacity to reduce the moisture of 18 tons per hour from 15 per cent to 1 per cent. The dried coal is discharged into a bucket elevator which raises the material 63 feet and discharges it onto a Hummer screen equipped with a ⅛ inch mesh screen. The coal particles retained by the screen are either crushed by a hammer type mill or used for

furnace fuel. The coal which passes through the screen is ready for use. At this point of the operation the binding material is introduced. This material is made very accurately. All the ingredients are automatically fed, and by using proper temperatures, correct speed and duration of agitation, a uniform binder is produced.

The quantities of coal and binder are electrically controlled so that excess quantities of either material are not used. The two materials are mixed together in a combination screw conveyor and paddle mixer. The conveyor moves the material along uniformly and the paddles pug the mix. The material as it leaves the mixing apparatus is fluffy and comparatively dry. It discharges into the feed hopper of the briquet press. The presses are of the Belgian roll type. The molds make a modified pillow-shaped briquet weighing approximately 2¼ ounces. The press exerts approximately 3,000 pounds pressure per square inch. The briquets are discharged onto a shaker screen which removes the fines made between the rolls and the pockets. This shaker screen also distributes the briquets evenly on a baking conveyor. The baking conveyor consists of pans 2 feet long and 8 feet wide made of iron mesh. These pans move along slowly and convey the briquets to the baking ovens. These ovens remove the water in the binder, dextrinize the starch content, and distill off the lighter oils from the asphalt. This makes the briquet hard, tough, and minimizes the odor and smoke. The baking ovens are heated by hot air which is introduced into the various compartments by fans. The briquets after issuing from the baking ovens are ready for loading.

Navicoal Corporation. The Lehigh Coal & Navigation Company, operating under the name of the Navicoal Corporation, has been experimenting for a number of years at Lansford. Recently their activities were transferred to Perth Amboy, N. J. After trying various binders with varying success, and without producing a briquet that satisfied their engineers, they turned to the problem of carbonization. They are now carrying on experiments with various types of soft coals to find the particular type which is most suitable to mix with anthracite to act as a binder in the carbonized briquet.

In the process of making a carbonized briquet varying quantities of soft coal slack are mixed with anthracite fines, ground thoroughly and pressed into shapes and then partially or wholly carbonized. These briquets are hard, smokeless, and seem to fill all of the requirements of a good briquet.

Varying quantities of bituminous coal are used, the idea being to use just enough to bind the anthracite particles together thoroughly and hold them in position until combustion is complete. This company sees a great future in the briquet industry and believes that it is one of the ways to utilize very fine-sized anthracite.

Anthracite Briquette Company. This company, located at Sunbury, Pa., is making briquets from coal dredged from Shamokin Creek. The coal is washed and screened. It is then pulverized and mixed thoroughly with approximately 6½ per cent of hydrolene (asphalt binder) under high temperature. The coal is then pressed into briquets which go to a cooling table. They stay on the cooling

table 40 minutes and then are loaded into a storage bin or onto railroad cars. The only material used in these briquets is anthracite fines and the hydrolene binder. They are not baked and are moisture proof.

St. Clair Coal Company. The briquet plant at St. Clair was completed in the summer of 1925. It is the Mashek Engineering Company's standard type "C-3" plant, which has a capacity of 20 gross tons per hour of $2\frac{1}{2}$ ounce pillow-shaped briquets. The coal is anthracite fines.

A drag line moves the coal from the storage pile to the elevator, which raises the coal to the dust bin. Under this bin there are two measuring feeders for regulating the quantity of the materials. These feeders empty into two steam driers, each of which has 1,200 square feet of effective drying space. An elevator takes the material from the driers and discharges it into a dry coal bin. From this bin a feeder with volume control attachments delivers the measured material directly to the pulverizers. The pulverizer crushes the coarse coal so that it passes through a 12-mesh wire screen.

A screw conveyor carries the pulverized material to an elevator which then discharges the coal into the preheater where the coal is heated to the proper temperature for mixing. The four mixers are placed under the preheater. The coal is there mixed thoroughly with the binder. It is then cooled sufficiently for crushing. From the mixers the coal and binder discharge into the briquet press hopper. A belt conveyor takes the briquets from the press to the oven where they pass through several chambers which are kept at different temperatures. The moisture is driven off and the lighter volatiles of the binder are distilled off. The baked briquets are taken from the oven to the cooling table where they are sufficiently cooled to remove all danger of ignition when delivered to the briquet bins.

This plant is equipped to use any of the standard binders such as sulphite, pitch, or pure asphalt.

Combustion of Briquets

Briquets burn like domestic sizes of anthracite except that less draft is needed. They are slightly more bulky in the fire pot, and a thicker fire bed is necessary to keep a fire for six or eight hours. Eight to twelve inches of fire bed on two or three inches of ash are generally necessary, depending upon the quantity of draft which is applied. A charge of twelve inches in moderate weather will last approximately eight hours. If the fire is governed by a thermostat no attention will have to be given it during this period. At night and in very temperate weather when it is desirable to maintain a very slow fire, the addition of one to two inches of buckwheat on top of the fuel bed will give very satisfactory results. In fact, a slight mixture of buckwheat at any time gives more body to the fire.

The binder softens soon after the briquets are put on the fire. During this period of softening the briquets should not be touched with any instrument because they will lose their shape and interfere with the passage of the draft through the fire pot. After a short

period the binder is carbonized and the briquets are extremely hard. When firing briquets as well as any other form of fuel, all drafts should be wide open. They should be open also when ashes are being taken out of the ash pit.

The combustion of briquets takes place gradually from the outside inward. A good briquet holds its shape until all the carbon is burned out of it. It does not clinker in the fire no matter how much draft is applied to it.

The ash of the briquet is very fine and should be wet down in the ash pit before the ashes are removed, to prevent finely divided particles of ash from flying over the furnace room. In fact, any ash pit should be wet down before it is emptied. This saves at least one-third of the dirt from a fire. In the morning the furnace should be shaken down until a faint glow appears in the ash pit. It is not necessary to shake the grate so much that bright particles of coal fall through into the ash pit. Always keep the ash pit clean. Full ash pits mean obstructed draft and burned out grates.

After shaking down the ashes place upon the fire from four to eight inches of briquets. After the combustion is started it is well to fire another small charge of briquets. The fire is then ready to heat the house for six hours.

At night or in mild weather when it is desirable to bank the fire, use a poker and move toward the part of the fire bed which is closest to the draft outlet one-half of the glowing briquets. Then fill up the fire pot with new briquets. These new briquets gradually ignite and all the volatile matter in them is driven off and is ignited by the hot coals before it passes up the stack. This method eliminates smoke and gives greater efficiency to the furnace. A layer of buckwheat on top of the briquets will still further retard combustion and in the morning will hasten the kindling of the fire because of the smaller size.

In using briquets the same care must be taken of the furnace as when domestic sizes of anthracite are used. The boilers of furnaces should be kept thoroughly tight and clean. The heating surfaces particularly should be cleaned when they are sooted up. Much heat is wasted when carbon is deposited upon heating surfaces. A very easy way of cleaning the entire furance and the flues is as follows: Turn on the drafts until a white hot fire is obtained. Throw on the fire from one to five pounds of common salt, the quantity of course being governed by the size of the furnace. In the ordinary household furnace three large handfulls of salt are necessary. All the salt should be thrown on at one time. After the salt has been thrown on, close the firing door and cut down the drafts somewhat.

The salt will remove all the dirt accumulations in the furnace and in the flues.

A good anthracite briquet is an excellent form of fuel for domestic use.

Other Fuels Manufactured from Anthracite

There has been much experimentation with other forms of fuel than briquets manufactured from anthracite. None of these fuels are now on the market but much is expected of them when the price of raw anthracite advances still farther. This advance in anthra-

cite is inevitable because of increased mining costs resulting from wage rates, the mining of thin coal, the exhaustion of thick coals of good quality, and the increased cost of pumping, for as mining progresses more and more surface water finds its way into the workings.

*Anthracoal.** Anthracoal is a fuel produced by coking anthracite in ovens similar to those used in the by-product coking of bituminous coal. The primary material is fine-sized anthracite and a mixture of coal tar pitch or other suitable binder. The resulting product is a hard, dense, homogenous mass with a silvery lustre and with a color varying from silvery to grayish black. When by-product coke made from bituminous coal is pushed from the oven it has a cellular structure caused by progressive coking from the outer part of the oven chamber inward. Anthracoal does not have this cellular structure but tends to break up into blocky masses. Anthracoal is denser than coke and is harder, tougher, and stronger. The following tables are taken from the paper by Mr. Markle:

Results of shatter tests on anthracoal and coke.

Test in per cent	Anthracoal		Good blast-furnace coke
	First barrel	Second barrel	
Moisture	0.77	0.76	Under 5, variation over 3 points
Sieve test:			
Through 2-in. screen	7.71	7.29	Under 40
Through 1-in. screen	1.37	1.56	
Through ½-in. screen	0.93	1.08	Under 8
Over 2-in. screen	92.29	92.71	Over 60
Shatter test:			
Through 2-in. screen	10.06	12.40	Under 16
Through 1-in. screen	2.66	2.06	
Through ½-in. screen	1.80	1.26	
Over 2-in. screen			
Hardness number	86.40	86.10	Over 81
Analysis:			
Ash	16.64	16.48	Under 11
Sulphur	1.17	1.10	Under 0.95
Volatile matter	0.77	0.27	
Fixed carbon	82.59	83.25	Over 87

Analysis of anthracoal in coke ovens at Syracuse.

Oven No.	Apparent specific gravity	True specific gravity	Porosity per cent	Volatile matter	Fixed carbon	Ash	Sulphur
7	1.046	1.717	39.2	1.35	79.85	18.18	1.11
10	1.124	1.896	40.8	3.23	76.13	20.64	1.15
13	1.015	1.649	38.5	2.65	80.00	17.35	1.15
22	1.004	1.636	38.7	2.90	77.94	19.16	1.16
38	1.044	1.696	38.5	2.22	79.23	18.55	1.06

*Taken in part from "Anthracoal, a new domestic and metallurgical fuel made by coking anthracite fines with coal tar pitch," by Donald Markle, Coal Age, August 25, 1921.

Analysis of anthracoal made from Lehigh Coal & Navigation Co. cleaned culm.

Moisture	0.20	Sulphur	0.52
Volatile matter	1.41	Apparent specific gravity	1.101
Fixed carbon	89.99	True specific gravity	1.8
Ash	8.4	Cellular space, per cent	38.85
		B. t. u's per lb	13,334
	100.00		

By cleaning the silt an excellent product can be produced which meets every requirement of the domestic user.

The process of manufacturing anthracoal is simple and is almost identical to the manufacture of by-product coke from bituminous coal except that a binder must be mixed with the primary material and the mixture well masticated. The coking time of anthracoal is seventeen hours.

Anthracoal can be crushed and sold in sizes to suit market conditions.

The percentage of binder varies with the kind of material to be briquetted and with the character of the binder. When pitch was used 14-25 per cent was added.

Analyses of pitch used for binding material.

Flake Pitch, No. 1		Flake Pitch, No. 2	
Melting point, degrees F.	265	Melting point, degrees F.	280
Fixed carbon	44.55	Fixed carbon	46.64
Volatile matter	54.39	Volatile matter	53.08
Ash	0.95	Ash	0.28
Moisture	0.11		

The average ash content of the culm used for anthracoal was 18.96. The volatile matter ranged from 7.42 to 6.52. The sulphur varied from 1.26 to 2.5 per cent. The silt was passed through a 3/64 inch round mesh screen.

Trent process briquets. The Trent process removes a large portion of the ash contained in raw coal by the use of an oil emulsion in water. When the coal is cleaned it emerges in the form of pellets which can be readily crushed by the fingers. These pellets are composed of oil and coal and some water. In order to manufacture the domestic fuel it is necessary to pass the pieces through a pre-heating chamber where the oils and other volatile products are extracted. The material can be pressed into various forms and shapes or used in its original form. The resulting material makes a hard, waterproof briquet having all the characteristics of good domestic fuel.

Summary

Anthracite briquets are now being manufactured on a commercial basis. They are a highly satisfactory domestic fuel.

Briquets offer a partial solution of commercializing fine sizes of anthracite for domestic use. When the fine sizes of anthracite are used at a profit or at least made to pay for themselves, it relieves

the pressure of mining costs on the domestic sizes, and should result in a reduction in their price.

Fuel briquets are manufactured in two ways: by mixing with binders and molding under pressure, or by mixing with bituminous coal and carbonizing.

Manufactured anthracite fuels can also be made by coking with other material and crushing the product into various sizes.

Briquets in the main are of two types: the type which is pressed in dies; and that which is made in large sizes, broken, screened, and sized like anthracite.

In the anthracite region thousands of tons of fine-sized anthracite are now being stored on silt banks or going to waste into the creeks which could be used for briquetting. The tables of analyses show that these banks vary greatly in ash content. Even the banks having high ash content could be used if a suitable market could be developed for the manufactured product. Comparatively new methods of separating the ash from fine-sized coal are now on the market and can profitably clean the material which has formerly gone to waste.

The briquetting industry could not use a large percentage of the fines which are produced in anthracite mining, but briquetting is one method whereby profits could be realized from material which the operators would like to utilize.

The future of the briquet industry is assured. It will be a matter of a few years until it is feasible to produce briquets in large quantities. With the increased price of domestic sizes, anthracite briquets make an admirable fuel to compete with natural anthracite.

Powdered Anthracite

When anthracite was first used in powdered form combustion engineers believed that at least 80 per cent of the coal should pass through a 200-mesh screen. Experimentation has shown that hard anthracite from the Northern Field will burn efficiently if 70 per cent of it passes through a 200-mesh screen. The end point of good efficiency seems to be in the vicinity of 70 per cent. When the powdered fuel falls to the bottom of the fire pit like showers of incandescent particles, the efficiency is lowered because combustion is not completed.

Anthracite can be used by itself in powdered form or in a mixture with bituminous coal. It is particularly desirable to mix some powdered anthracite with powdered high volatile bituminous coal to prevent possible spontaneous combustion in the coal bins and to minimize the danger of back fireing in the feed pipes.

Equipment. A powdered coal plant consists of a pulverizer which converts the raw coal into material of the desired mesh. This may range from 40 to 90 per cent through 200 mesh. The coal is then screened and dried and fed directly to the boilers.

Two systems are in prevalent use. First, the unit system in which one machine pulverizes, prepares and delivers the coal to the furnace, and second, the multiple system in which the coal is prepared in one building and is transported to another building for storage or for burning. The multiple system is in most prevalent use although the unit system is gaining in popularity.

The unit system is very compact and particularly desirable where space is at a premium. It consists of an elevator to deliver the coal to a hopper from which the coal is fed by various means through the pulverizer. After the coal leaves the pulverizer it is sent directly to the feeders without storage.

In the multiple system which is alleged to be more efficient under conditions in large plants, the coal is crushed, dried, and pulverized in a separate building or separate room. The coal is then transported by screw conveyor or compressed air to bins near the furnace where it is fed automatically to the feeders.

Drying. Powdered anthracite like bituminous coal must be dry before it is fed to the furnace. Silt contains a large percentage of moisture. To procure good efficiency, it must be dried so that it contains only 1 to 2 per cent moisture. If it is moist it arches and packs in the storage bin and clogs readily in the screw conveyor. It is often desirable to dry anthracite before pulverizing it because more power and time is consumed in grinding wet coal than dry coal.

The driers are of several types, mostly rotaries. This equipment consists of an inclined cylindrical shell fitted with rollers which is rotated slowly by a motor. The rate of passage of the coal through the drier can be regulated at will by changing the inclination of the shell and the speed of rotation. The coal is dried by burning coal in a furnace which is part of the drier. The hot gases from the furnace pass over the coal which is to be dried. Some driers pass the hot gases over the shell of the drier and then after they have cooled somewhat they are passed over the coal. This type is the best and safest. The coal is rotated until it has the desired moisture content.

Pulverizing. After the coal is dried it passes directly to the grinding mills. There are numerous types of these mills. Much of the coal is ground in the well-known ball and tube mills. Generally the coal is ground in high-speed pulverizing mills. More power is required to pulverize coal as the particles decrease in size.

Specifications as to size vary with the type of fuel and the furnace equipment. It is generally recommended that 95 per cent of the pulverized fuel should pass through a 100-mesh screen and 80 to 85 per cent of it should pass through a 200-mesh screen. The more finely divided coal burns rapidly and ignites the larger particles. If the particles are too large they are not combusted completely and either go up the stack or fall into the ash pit. This condition not only impaires the efficiency of the boiler but seriously slags the tubes. The smaller the coal the more rapidly it burns.

Distribution. After the coal has been pulverized it is transported to the burners. This distribution takes place in two ways. The indirect system of distribution moves the coal forward by screw conveyor or compressed air to bins situated near the furnace. The coal is moved from the bins to the furnace by a screw or other means. In the direct system the coal is blown directly to the furnace from the grinding room by a low-pressure air current. With the indirect system separate bins and feeders are required for each furnace. The cost of this installation is greater than that of the direct system,

but it minimizes the danger of explosion. It gives greater control over the rate of feeding the coal to the furnace and the storage gives some leaway in the operation of the furnace in case the drying or pulverizing equipment should break down.

Feeders, mixers, and burners. There are numerous equipments on the market for the introduction of powdered fuel into the boiler. The mechanism varies somewhat, but in the main the idea is the same. The powdered fuel is aerated and blown into the furnace by a feeder which spreads it in the desired direction.

One of the standard burners consists of a fan-shaped nozzle surrounded by control passages through which air is introduced. The burners are set in the arch with the nozzles at right angles (some are inclined slightly) to the front wall. The feeders in certain instances consists of a cast iron screw of variable pitch revolving in an enclosed casing which forms the bottom of the hopper. Coal is fed to this screw by gravity through a hopper frame which is bolted to the bottom of the pulverized fuel bin. The screw is driven by a variable-speed electric motor. Coal is carried to the end of the feeder by this screw. There it comes in contact with a stream of air, and is thoroughly mixed by means of a revolving paddle wheel. This mixture is like a heavy mechanical gas and is carried to the furnace through a wrought iron pipe. About 10 per cent of the air required for combustion is introduced into the feeders and sufficient pressure is provided to carry the coal through the pipe to the burner.

Burning. Powdered coal is efficient because it can be burned almost completely with a very low excess of air.* Low excess air causes high furnace temperature which in turn causes fusion of ash and erosion of furnace linings. Many of the first attempts to burn powdered coal failed because of the excessive erosion of furnace lining. Another cause of the early failures was the difficulty of removing fused ash from the furnace. A large part of the ash was spread in a molten state on the walls and bottom of the furnace. This molten ash ran down and washed the brick along with it and accumulated in the bottom in a puddle. The only way to remove this molten ash was to cool the boilers and break it with a pick. This difficulty led to the design of a furnace which is practically water cooled. A water cooled furnace largely solves the difficulty of erosion of the side walls and accumulation of molten slag on the bottom.

Hollow wall construction has met with considerable success in relieving the erosion on the side walls. Hollow walls are built with channels between the furnace lining and the outer wall and through these channels 60 to 80 per cent of the air needed for combustion is passed before it enters the furnace. The air which passes through the hollow walls cools the furnace lining and reduces the erosion. No air outlets lead directly from the outside to the furnace through which a flame might puff back into the boiler room.

*Many of the statements in the discussion of burning powdered anthracite are taken from "A review of recent applications of powdered coal to steam boilers" by Henry Kreisinger, American Institute of Mining and Metallurgical Engineers annual meeting, New York, December 1924.

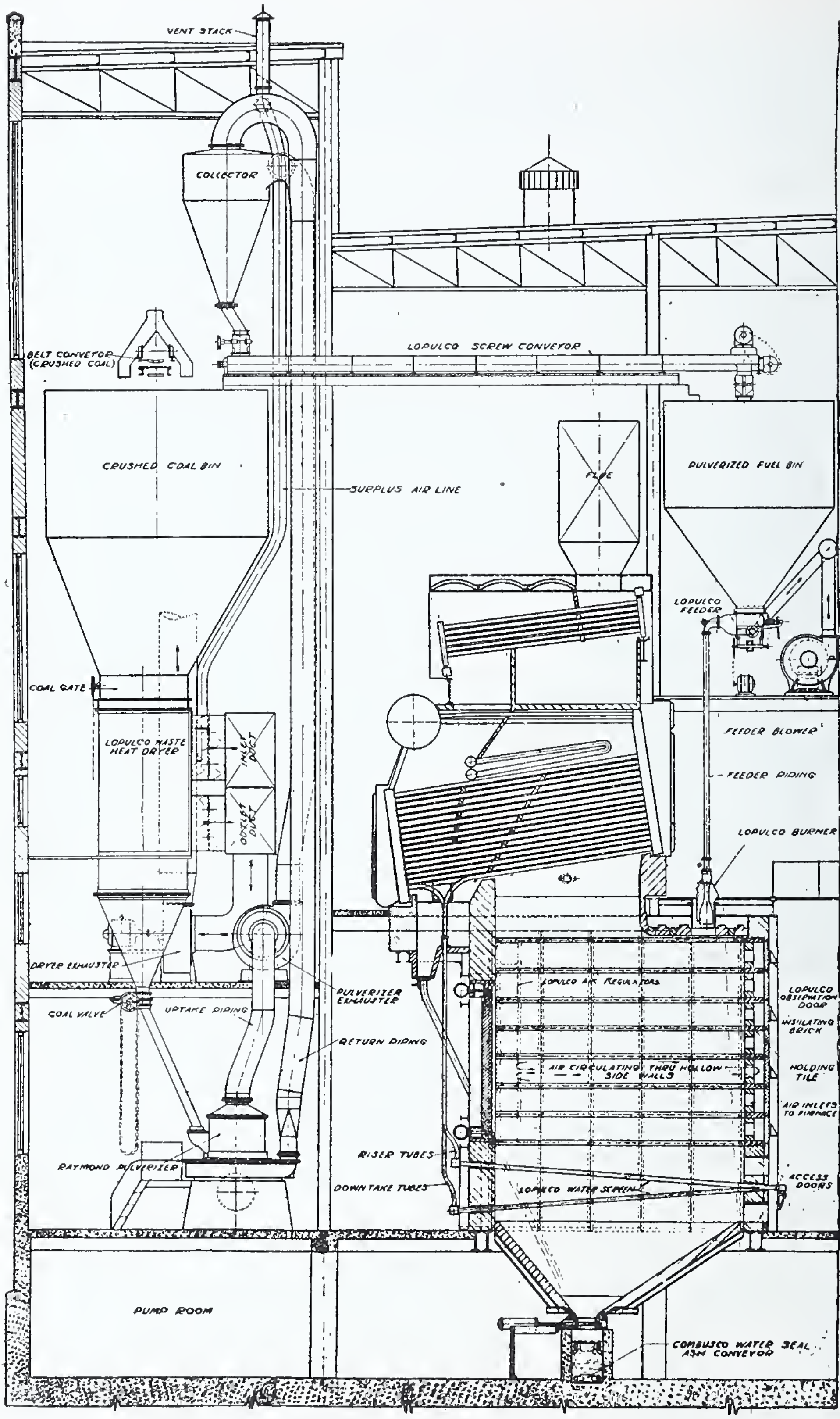


FIGURE 18

Section through boiler plant equipped with Lopulco pulverized fuel system.

Powdered coal furnaces are made large for two reasons: first, to obtain complete combustion, and, second, to avoid impingement of the flame against the furnace walls. Powdered fuel is burned while in suspension in air. The particles of powdered coal require from 1 to 2 seconds to burn almost completely. A large furnace must be provided to permit these particles of coal to stay from 1 to 2 seconds in the combustion space.

The furnace for burning powdered fuel should be larger than the ordinary furnace. It should be either air-cooled or water-cooled and should have additional means of varying the supply of air. If the furnace is not air- or water-cooled the flame from the burner must be adjusted so that none of the slag falls upon the side walls. The ash can be removed from the bottom by continuous streams of water. Provision must be made so that the powdered fuel can be introduced into the combustion chamber from the top.

Costs. The cost of preparing fuel for burning in pulverized form ranges from 50 to 90 cents a ton. These figures include the charging off for depreciation, interest, taxes, and insurance, in addition to labor, drier fuel, power, and repairs. When the coal to be powdered is on or near the site of the boiler plant it can be pulverized for as low as 30 cent a ton.

Plants Using Pulverized Anthracite

Numerous industrial plants in the eastern United States are using small quantities of anthracite in pulverized form.

The Susquehanna Collieries Company is pulverizing anthracite slush and using it in their Lykens and Lytle plants. The Metropolitan-Edison Company is using powdered anthracite at the Middletown plant.

Susquehanna Collieries Company, Lykens plant. This company has a large quantity of fine-sized anthracite in storage which has been settled out of breaker water. This fine-sized coal has excellent quality and is pulverized without cleaning. The coal is scraped into a discharge hopper and conveyed to raw-coal bunkers. From there it is passed into two 25-ton per hour hand fired, double-shelved driers. The coal is reduced to 1 per cent moisture. After the coal is discharged from the driers it is elevated into a dry-coal bin located directly over the pulverizing room.

The screen test of the slush as it is fed to the mills is about 70 per cent through 3/64 inch mesh screen, and the finished material leaving the mills is approximately 82 per cent through 200 mesh. This fine grinding appears necessary with anthracite slush in order to obtain proper ignition.

After the coal is ground it is discharged into screw conveyors which in turn feed the duplicate systems of bucket elevators which carry the coal to a point above the boiler bunker level. It is conveyed from here by a duplicate set of screw conveyors to the fuel bins above the boiler, from which it is fed into the burners. The coal is ignited under a coal boiler by means of a kerosene torch. In less than a minute the coal maintains its own combustion.

The combustion chamber is extended out in front of the boiler in order to get a good burner setting. The floor of the chamber slopes

at an angle of 45 degrees from the bridge wall to within 4 feet of the front wall. The narrow portion at the front of the chamber serves as an ash pit. The ashes are removed from the pit by sluicing. The discharge from the mine pumps is run through the pit.

Each of the 6 boilers is fired by one burner located in the arch which forms the top of the combustion chamber extension. The opening in each burner is approximately 2½ inches wide by 5 ft. 2 inches long. Each burner discharges directly against an attached deflector, the position of which is controlled by a chain and screw operated from the floor. In this manner the flame travel can be adjusted at will. Provision is also made in the cast iron housing surrounding the burner for admitting secondary air. A damper in the top of the housing is operated from the floor.

*Metropolitan-Edison Company, Middletown station**. This power plant is located on the Susquehanna River near a large supply of river coal. This plant pulverizes the river coal and mixes it with bituminous coal.

Distribution of the coal in the bunker of the pulverizing house is by means of a belt conveyor fitted with a plow distributor. This bunker is divided into four compartments for convenience in mixing river coal with bituminous coal. The weigh larry which travels beneath the bunker and serves the pulverizing mill is also divided into two compartments to facilitate mixing. By means of this larry and instruments to measure the power required to drive the different mills the company will secure an accurate comparison of the cost of preparing coal by each mill in the plant. Five pulverizing mills are installed, two Fuller, two Raymond and one Hardinge.

At present four dryers are installed, two Wood dryers and two Fuller-Randolph dryers. The two Wood dryers deliver to the Hardinge mill and one Randolph dryer delivers to a Raymond mill, while the other delivers to a Fuller mill. Plans call, however, for the installation of two more Randolph dryers to serve the other two mills. The Wood dryers use the stack gases and exhaust steam for heating the coal to drive off the moisture. A steel plate fan draws the gases from the stack breeching through the coal in the dryer and discharges it to atmosphere through a cyclone collector that prevents the waste of coal dust. To prevent the danger of overheating the coal, indicating and recording thermometers are used to show the temperatures of the gas and the coal from the dryers. The Randolph dryers are heated by exhaust steam from the main plant. They also use flue gas for carrying off the moisture. The pulverized coal is transmitted to the boiler room bins through piping by means of two Fuller-Kenyon pumps. When the boiler room bins are full, indicating lamps in the pulverizing house light up, giving warning to the attendants. When a bin is full the coal is automatically diverted to the next bin. Another interesting feature of the coal handling equipment is the electrical interlocking system employed on the elevating and conveying machines by means of which the entire system from the track hoppers to the bunker in the pulverizing house starts and stops in proper sequence, no matter from which control point the equipment may be operated. So completely automatic is the machinery in the pulverizing house that only three men are required

*Description taken in part from "Susquehanna River Station of Pennsylvania-New Jersey Super Power System," Power Plant Engineering, July 15, 1925.

on a shift to operate it. All the switches controlling the motors in the pulverizing room are located in a switchroom carefully partitioned off from the other part of the building, as a precaution against an electric spark starting an explosion. The building is heated by exhaust steam from the station auxiliaries, Nash Engineering Co. pumps being employed to return the condensate.

Each unit of the plant will have four boilers set in two rows of two, each row being served by one stack. At present only three boilers are installed. These are Connelly four-pass boilers, each rated at 1477 hp., generating steam at 350 lb. gage. The auxiliary piping carries saturated steam but the main piping to the turbine carries steam of the same pressure but superheated to a total temperature of 660° F. The furnaces serving these boilers are built for a vertical flame, the volume above the water screen being 11,000 cubic feet, and the width 24 ft. 1½ in. The construction is such as to provide horizontal air ducts between the lining and outer wall through which secondary air is passed from registers at the rear and sides to ports in the front lining of the furnace. The water screen is in the direct circulation of the boiler. American arches are used in all the furnaces, but the company is testing out several different makes of fire brick and cements.

In the first unit of the plant two makes of economizers are used, Foster economizers in one row of boilers and Sturtevant in the other. Careful accounts are being kept to determine which gives the better service record. The heating surface in the economizer is equal to 50 per cent of that in the boiler which it serves. Two induced-draft fans for each boiler draw the gases through the economizers and deliver them to the breeching which is of the accordion type, manufactured by Connery & Co.

From the coal bins, of which there is one for every boiler, two groups of three feeders each, driven by two 12-hp. brush-shifting variable-speed motors, deliver the coal to the six burners which are provided for each boiler. This equipment, which was furnished by the Combustion Engineering Corp., is designed for 35 per cent primary air; the 65 per cent secondary air enters at the front of the furnace as previously described. The primary air, that which enters with the coal in the burner, is supplied by motor-driven fans, one being provided for each two boilers. The pressure carried is 15 inches of water. The secondary air is drawn into the furnace by the draft created by the induced-draft fans, which are driven by 125-hp. slip-ring motors capable of running at three different speeds. This draft is measured at five different points and indicated by a Bailey multi-pointer draft gage on the boiler control board upon which is also mounted a Bailey boiler meter which gives the steam-flow, air-flow indications. There is also a recorder showing the temperature of the water and the flue gas entering and leaving the economizer. The boiler attendants are kept informed as to the load on the station by a Payne-Dean load indicator.

Ashes accumulating in the bottom of the furnace are discharged into a sluice which carries them into the yard where they are used for filling purposes. This sluice is built without slope but the ash is carried along with water from high pressure nozzles spaced along the length of the sluice. Cinders carried over to the third and fourth passes of the boiler also are being sluiced out into the yard.

SILT, CULM, AND BREAKER DISCHARGE CONDITIONS AT COLLIERIES AND IN THE STREAMS

Introduction

During the summer of 1925 practically all the collieries producing anthracite were visited to investigate what disposition was being made of the breaker water; to estimate the contents of culm and silt banks; and to observe the methods in use for the recovery of fine sizes from breaker water.

It was impracticable to visit each breaker at length. Some omissions of data may be observable to those who are familiar with the anthracite fields, but in the main all important information concerning the subject of production and utilization of fine sized anthracite is discussed.

Unfortunate circumstances prevented the entry of the writers upon certain properties. However, the information concerning these properties is from most reliable sources.

Each stream was carefully studied, and observations were made of silt accumulations.

Methods of Handling and Storing Silt

Description of common methods. The choice of a method of disposing of silt depends largely upon the available storage space and the topography of the location. There are several methods of storage in general use in the anthracite field. The principle of these are: (1) level banks with retaining sides composed of silt and lumber, (2) settling basins impounded by previous embankments of rock or cinders, (3) dewatering and desliming in a settling tank and stacking by inclined conveyor, (4) settlement in special thickeners and stacking thickened solids, (5) filling old strip pits, (6) filling mine workings, and (7) direct disposal to a stream.

In the first method the silt is carried from the preparation plant by a stream of water flowing in a trough. It is discharged upon the bank and the stream meanders over it at low velocity, or spreads out over it in a thin sheet so that the silt or the coarser part of it is deposited on the surface of the bank. The settling action is improved by keeping an embankment of silt built up around the edges of the bank. This prevents the water from running off rapidly and washing silt away with it. Sluices, usually made of wood, carry the drain water away from the bank. The inlets to the sluices are boarded up a little above the general surface level of the bank so that a shallow pool of practically still water is maintained around the sluice and over at least a part of the bank.

In the second method a basin is formed by building a retaining bank or dam of cinders, mine rock, or other refuse material which will make a pervious wall. This is usually accomplished without

building a complete enclosure, by locating the bank in a natural basin, a small stream valley, or on a hillside. The water and silt are discharged into the basin and form a pool in which the silt settles to the bottom and the clarified water drains out through the bank. At some collieries these basins have been made on top of rocks banks so that the water can filter down through the bottom as well as through the embankments.

In the third method the silt and water from the preparation plant are discharged into a rectangular wooden tank in which the coarser part of the silt settles to the bottom and the water and slime overflow the sides. This is in effect a large elevator boot. The silt that settles to the bottom is taken up by a slow-motion, perforated bucket elevator which drains out enough of the remaining water so that the silt can be stored in piles with very little loss in run-off.

In the fourth method the settling tank is replaced by the more efficient thickener which is a more effective means of settling the solids and clarifying the water. The various types of thickeners are described in another chapter.

The fifth method is very generally used where old strippings are available. The silt and water flow into the stripping. The water usually drains into underground workings and is eventually pumped out with the mine water.

The sixth method is used principally at collieries which operate under a city or other valuable surface property where it is necessary to take all possible precautions to support the surface. The silt is usually flumed with the breaker water and slate (pulverized in hammer mills) to bore holes, which carry it underground where it is distributed to the proper chambers by pipe lines.

At a few collieries the silt and water are discharged directly into the streams without any attempt to save the silt or to clarify the water.

Effectiveness of settling methods. The various methods of impounding the silt are used with varying degrees of effectiveness. If the water finally runs off the bank in a stream it carries some fine silt with it. No bank of this type was visited that completely retained the silt, although some were sampled where the run-off water carried practically nothing coarser than 100 mesh.

Basins that are surrounded by pervious rock embankments or built on top of rock banks generally retain the silt most effectively. A number of these banks which were studied discharged clear water and obtained 100 per cent settlement of the silt. Complete settlement is accomplished also, in some cases, where old strip pits are used as settling basins, at least in so far as any surface discharge of silt-laden water is concerned.

When settling tanks are used for dewatering the silt before storing it, the percentage of silt which is saved depends primarily upon the size of the bank, width of overflow, and volume of water which is handled. Most of the installations examined were inadequate in size and a large proportion of the silt was lost. A screen analysis of settling tank overflow that is typical of ordinary practice showed 57.8 per cent through 200 mesh; 80.9 per cent through 100 mesh, and 96.4 per cent through 50 mesh.

The effectiveness of the thickener, like the settling tank, depends upon its size, width of overflow and the volume of water it handles. The 90-foot Dorr thickener at the Sayre Colliery handled 1,550 gallons of water per minute and discharged an effluent containing .048 pounds of solids per gallon; 93.4 per cent of this solid matter was finer than 200 mesh.

Effect of storage method on quality of silt. The size and purity of silt recovered from the waste water is greatly influenced by the method of handling. All banks, settling basins, or tanks act as classifiers and deslimers unless complete retention of the silt is obtained, and this is unusual. The extent to which fines are removed depends upon the effectiveness of the settling action. The classifying action of the settling basins also influences the ash content of the silt which is retained. Where the silt is settled in a series of basins, with the water overflowing from one to another there is a marked reduction in size of the material and in ash content in each succeeding tank. The silt which is carried away is cleaner than the same sizes of material which are retained in the bank. This is particularly important where a small settling tank is used to deslime the silt before it is used. The fine clayey material is removed and there is also a tendency to remove larger clean coal and concentrate the dirt in the retained product. Desliming by a rough screening operation would probably improve the quality of the deslimed product which is retained.

Stream Conditions in the Southern Anthracite Field

The Southern Anthracite Field is drained by Nesquehoning Creek, a tributary of the Lehigh, Panther Creek, and Little Schuylkill River, the West Branch of the Schuylkill and its tributaries, Swatara Creek, and Wiconisco Creek.

Nesquehoning Creek flows into the Lehigh at Coalport. It carries silt from the Lehigh Coal & Navigation Company, Nesquehoning Colliery, and the Hauto washery of that company. There is a large accumulation of silt in the creek valley at Nesquehoning and the creek banks are lined more or less with silt accumulations to the point of confluence with the Lehigh. The water is black. Nesquehoning Creek flows through a sparsely populated territory and no damage is done along its course. The flood plain is comparatively wide at the town of Nesquehoning and little difficulty is had with the deposition of silt.

Panther Creek originates in the mountains 1½ miles east of Lansford. Six or more collieries drain their silt and wash water refuse into this creek. It flows through a narrow valley and there are silt accumulations practically everywhere in its channel except at points where the bank is built up with rock or walled in by other means. The channel is clean through Lansford and Coaldale and the largest accumulations start just west of Coaldale. In the vicinity of the Lehigh Coal & Navigation Co's. Tamaqua Colliery, 1 mile east of Tamaqua, a large accumulation of silt is being washed into the Little Schuylkill.

The silt and culm banks in this valley are well protected and the quantity of silt in the valley is small in comparison to the tonnage of coal produced. Steep pitch mining also necessitates the

piling of much refuse along the creek valley. These deposits are well protected and not much silt goes into the stream. The accumulations along the stream are old.

Little Schuylkill River drains part of the Eastern Middle Field but its gradient is steep and its channel is kept clean as far south as Tamaqua. At this point material eroded from old abandoned culm piles joins with the silt which comes from Panther Creek. The water of the Little Schuylkill from Tamaqua south is black and turbulent. More silt is added south of Tamaqua from old culm banks and from Kresge Washery. Where Little Schuylkill River leaves the anthracite region it carries much solid material.

Schuylkill River has its headwaters on the mountain one mile northwest of Tuscarora. Mary D Colliery of the Hazle Brook Coal Company is located on this watershed. Another branch of the head waters drains the wash water and silt from collieries in the vicinity of Tuscarora. Although care is taken in settling the silt at Mary D Colliery, some of it goes into the river. The smaller operations in the vicinity of Tuscarora also discharge silt into the stream. From Tuscarora southwest to Port Carbon the river drains through an area in which mining has been practically abandoned for a number of years. Old culm piles are being or have been worked over and the wash water from these banks has gone into the stream. Six or more active collieries discharge silt into the stream between Middleport and Port Carbon. At Middleport a small stream is eating away a culm bank which was deposited there many years ago. All of these factors tend to laden the waters of Schuylkill River heavily with silt, with the result that keeping the channel open has been a problem at Port Carbon. This channel has been cleaned out but silt is deposited in it each year. At Pottsville the Schuylkill obtains additional water but not enough to keep the channel in good condition between Pottsville and Schuylkill Haven. In this locality the flood plain is built up with many feet of silt. Where the river cuts through Sharp Mountain the gorge is narrow and the current is swift enough to keep its channel clean. Some larger coal is being recovered from deposits between Pottsville and Schuylkill Haven. The West Branch joins Schuylkill River at Schuylkill Haven and it adds large quantities of silt to the stream. The condition of the Schuylkill will be discussed further under the heading "River and Creek Coal."

The West Branch of Schuylkill River is heavily laden with silt. It drains an area in which are located collieries having an enormous daily output. Practically all of these collieries have settling tanks but even under the best of conditions some silt gets into the creek. In addition to active collieries, dozens of old culm and silt banks are located in its drainage area and these banks form a source of stream pollution. Some of these banks have been worked over and have added silt to the stream valley. Some are without any protection and in one or two instances the creek runs directly through them. Others are eroded at times of high water. Minersville and Llewellyn have difficulty with silt and culm accumulation at various seasons of the year.

Swatara Creek drains an area within the mountains which is very sparsely populated excepting the towns of Tremont and Donaldson. Four active collieries are discharging some silt into this stream. As

in the case of the Schuylkill the current silt discharge is much augmented by the erosion of old silt and culm banks. Large banks at East Franklin and Rauch Creek Collieries have been worked over. The refuse from these banks is lying unprotected and is washing into the creek. The three branches of Swatara Creek have steep gradients and keep their channels clean. Little difficulty is experienced in keeping this stream from doing property damage. Swatara Creek leaves the anthracite region through a gorge in Second Mountain. Here the current is swift and little deposition has taken place. The valley broadens as it flows through farming country and the flood plains are covered with several inches of black, sticky mud and silt.

Wiconisco Creek originates on the north watershed of Stoney Mountain, 2 miles southwest of Tower City. Three active collieries discharge some silt into this creek. Three accumulations of silt and culm are located on the drainage of this creek. Two of them are not protected and some wash occurs. The other bank is well protected and contributes very little silt to the stream. The water of Wiconisco Creek is black but there is very little evidence of silt deposition the entire length of its course. The current silt production is being well taken care of by settling on well-kept banks.

Silt and Culm Conditions at Collieries in the Southern Field

1. *Susquehanna Collieries Company. Short Mountain Colliery.*

Location: Lykens.
Drainage: Into Wiconisco Creek.

The water from this breaker is pumped into a settling tank on the hillside above it and the silt is scraped onto a storage pile. This bank contains 500,000 tons of silt and is being used for pulverized fuel in the boiler rooms.

A bank of silt containing 1,000,000 tons is leased to the American Briquet Company. Very satisfactory briquets are being made out of it. The water issuing from this operation is black and contains some silt.

An old culm bank, containing 500,000 tons is covered up with ash and rock. They are now moving the overburden to get the culm.

2. *Susquehanna Collieries Company. Williamstown Colliery.*

Location: Williamstown.
Drainage: Into Wiconisco Creek.

This colliery has a good settling basin with 25,000 tons of good silt in it. The silt is well settled and very little goes into the creek. A silt bank from an old washery on the mountain side 2 miles northwest of Williamstown contains 20,000 tons. A bank at the breaker has rock and ashes in it. An unsuccessful attempt was made to work it. This bank contains 750,000 tons.

3. *Philadelphia & Reading Coal & Iron Co. Brookside Colliery.*

Location: ½ mile north of Tower City.
Drainage: Into Wiconisco Creek.

The water from this breaker is discharged on top of a culm and silt bank containing 3,500,000 tons. The water is well settled and very little silt finds its way into the creek. Rock is piled around the bank.

PLATE IV

A. Silt bank at Alliance Colliery. The entire valley bottom is filled with silt.

B. Wiconisco Creek near Elizabethville. The banks are covered with black slime, but silt deposits are rare on this creek.

3A. *Philadelphia & Reading Coal & Iron Co. Rauch Gap Colliery*

Location: On Cold Spring Mountain above Dauphin.
Drainage: Into Rauch Creek.

A culm bank containing 100,000 tons of fairly good material has been lying at this site for 50 years. Each year some of it washes away. The colliery is abandoned.

4. *Philadelphia & Reading Coal & Iron Co. Good Spring Colliery.*

Location: Good Spring .
Drainage: Into Good Spring Creek.

This breaker has a settling tank and the silt is scraped up onto a well kept bank containing 3,000,000 tons. Very little silt goes into the river.

5. *Philadelphia & Reading Coal & Iron Co. Lincoln Colliery.*

Location: 1 mile northwest of Lorberry Junction.
Drainage: Into Lorberry Creek.

The breaker water is settled on a well kept bank. The discharge is shifted from time to time, and as banks are formed another location is chosen for silt accumulations. Some coal goes into the creek. A bank containing 4,500,000 tons of silt and culm has been worked with good results.

6. *Philadelphia & Reading Coal & Iron Co. East Franklin and Lower Rauch Creek Collieries.*

Location: East Franklin and Rauch Creek.
Drainage: Into Lower Rauch Creek.

A bank of silt containing 500,000 tons is gradually washing into the creek. The culm has been worked over and refuse piles are a source of stream pollution. These collieries are abandoned.

7. *Philadelphia & Reading Coal & Iron Co. Colkert Colliery.*

Location: Donaldson.
Drainage: Into Good Spring Creek.

There is no silt at this location. A culm bank on the hillside has been worked over. A good bank in the valley containing 100,000 tons has not yet been worked. Some of it is washing away.

8. *Philadelphia & Reading Coal & Iron Co. Middle Creek Colliery.*

Location: Middle Creek.
Drainage: Into Middle Creek.

This colliery has a settling tank and scraper line. The silt is scraped up onto a bank which is eroded by heavy rains, and some of the silt goes into the creek. There is no culm.

9. *Lehigh Valley Coal Company. Blackwood Colliery.*

Location: Blackwood, south of Llewellyn.
Drainage: Into Swatara Creek.

500,000 tons of mixed culm and silt have been deposited in the creek bottom. It is good material, but is rapidly being washed into the creek, as it is unprotected.

PLATE V

A. Middle Creek near its mouth. Silt bars are very numerous.

B. West Branch of the Schuylkill near Llewellyn. Silt in the foreground.

10. *Philadelphia & Reading Coal & Iron Co. Old Silverton Colliery (now Kresge Washery)*

Location: Silverton.

Drainage: Into West Branch of Schuylkill River.

This washery was formerly working a bank of silt and culm. The bank contains 800,000 tons, of which 500,000 tons is silt and 300,000 tons is culm. This bank is fairly well protected, but some of it is washing into the creek.

11. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: 1 mile south of Branchdale.
Drainage: Into Middle Branch of Schuylkill River.

An old culm bank containing 100,000 tons has never been worked. It is 60 to 80 per cent coal and contains a large percentage of domestic sizes.

12. *Philadelphia & Reading Coal & Iron Co. Otto Colliery.*

Location: Branchdale.
Drainage: Into Middle Branch of Schuylkill River.

Very little attempt is made to settle the silt at this breaker and much of it is going into the stream.

A 5,000,000 ton culm pile containing 60 to 80 per cent coal has not been worked.

13. *Philadelphia & Reading Coal & Iron Co. Phoenix Park Colliery.*

Location: 1½ miles south of Forestville.
Drainage: Into West Branch of Schuylkill River.

This breaker is equipped with a settling tank. The silt is scraped from the tank to a silt pile containing 3,000,000 tons. The water is fairly well settled.

A culm pile in the valley west of Phoenix at York Tunnel contains 200,000 tons. They are cleaning it at Phoenix breaker. A good culm bank at the breaker contains 2,000,000 tons which is now being worked. A large quantity of coal leaves this property with flood waters and heavy rains.

14. *Susquehanna Collieries Company. Lytle Colliery.*

Location: Lytle.
Drainage: Into West Branch of Schuylkill River.

The water from this breaker is settled well on a bank and the silt is being pulverised to barley size. The bank contains 1,500,000 tons. There is no culm.

15. *Lytle Washery* (abandoned).

Location: Forestville.
Drainage: Into West Branch of Schuylkill River.

The culm pile has been worked over and a silt and refuse bank containing 300,000 tons is well protected. However, some of the material goes into the stream during high water.

16. *Pine Hill Coal Company. Pine Hill Colliery.*

Location: 1½ miles northwest of Minersville.
Drainage: Into West Branch of Schuylkill River.

The silt from this breaker is fairly well settled on a bank containing 3,500,000 tons. This bank is in good condition although some of it is washing into the stream. There is no culm.

A. Silt deposits near Oak Hill Colliery, Pine Hill Coal Co.

B. St. Clair Colliery silt bank. An example of an efficient bank.

C. Culm bank near Pine Knot Colliery, Philadelphia & Reading Coal & Iron Co.

17. *Wolf Creek Washery.*

Location: 1¼ miles northwest of Minersville.
Drainage: Into West Branch of Schuylkill River.

The water from this breaker goes directly into a creek after being partially settled on a bank. The water contains much fine material. The bank contains 150,000 tons.

150,000 tons of culm remain.

18. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: 1 mile northwest of Minersville.
Drainage: Into West Branch of Schuylkill River.

An old bank containing 100,000 tons of culm has not been worked over. It is only fairly well protected, and some of it washes into the creek each year.

19. *Pine Hill Coal Company. Oak Hill Colliery.*

Location: Duncott.
Drainage: Into West Branch of Schuylkill River.

The silt from this breaker formerly went directly into the stream. They are now settling it fairly well in an improvised pond.

Old culm banks aggregating 4,000,000 tons are now being worked by a Chance separator. It is poor material and contains from 25 to 30 per cent coal. Much of this material is going into the stream.

20. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: Buckley's Station, 1¼ miles northeast of Minersville.
Drainage: Into West Branch of Schuylkill River.

A bank containing 350,000 tons of good material has never been worked. It probably contains 75 per cent coal. The finer sizes have been washing into the creek during heavy rains.

21. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: 1 mile north of Minersville.
Drainage: Into West Branch of Schuylkill River.

An old culm bank containing 50,000 tons has never been worked. It is good material. Some of it has been washing into the creek.

22. *Black Heath Coal Company.*

Location: 1½ miles northwest of Minersville.
Drainage: Into West Branch of Schuylkill River.

The silt is well settled on two banks aggregating 75,000 tons. Very little material is going into the stream. There is no culm.

23. *Philadelphia & Reading Coal & Iron Co. Buck Run Colliery.*

Location: 1 mile south of Glen Carbon.
Drainage: Into West Branch of Schuylkill River.

The breaker water is settled on a perfect settling basin containing 2,500,000 tons. Very little coal gets away. There is no culm.

24. *Philadelphia & Reading Coal & Iron Co. Glen Dower Colliery (abandoned).*

Location: Glen Carbon.
Drainage: Into West Branch of Schuylkill River.

The silt from this old breaker is accumulated in the creek valley. There are 300,000 tons of fine material. Much of it is washing away.

A culm pile containing 3,000,000 tons is located along the creek. It has never been worked. It contains probably 70 per cent coal. Some of this bank is also washing into the creek.

25. *Philadelphia & Reading Coal & Iron Co. Richardson Colliery.*

Location: Glen Carbon.
Drainage: Into West Branch of Schuylkill River.

The silt is settled along the creek bottom 1 mile east of the old breaker. It is gradually washing away.

Several piles of culm aggregating 3,000,000 tons have never been worked. This material contains practically 70 per cent coal and a large percentage of pea and nut. Some of this material is washing into the stream each year.

26. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: 1 mile east of Glen Carbon on the north side of the road.
Drainage: Into West Branch of Schuylkill River.

A small bank of culm containing 35,000 tons is of good quality and has never been worked.

27. *Philadelphia & Reading Coal & Iron Co. Thomaston Colliery (abandoned).*

Location: 1 mile west of Heckscherville.
Drainage: Into West Branch of Schuylkill River.

Silt accumulated from the old breaker and from the washery aggregates 1,300,000 tons. This silt is in the creek valley and is washing badly.

The washery is now working an old culm bank containing 1,500,000 tons. Much fine-sized material from this operation is going into the creek.

28. *Philadelphia & Reading Coal & Iron Co. Anchor Washery.*

Location: ½ mile west of Heckscherville.
Drainage: Into West Branch of Schuylkill River.

The silt from this washery is settled in the creek valley and is

not well dammed up. Much of it goes down the stream. The accumulation contains 300,000 tons.

This washery is working an old clum bank which is practically gone. One culm bank containing 200,000 tons has good quality. Another bank ½ mile north of the washery contains 700,000 tons. There is some silt in it.

29. *Pine Hill Coal Company. East Ridge Colliery (abandoned).*

Location: Heckscherville.
Drainage: Into West Branch of Schuylkill River.

A silt bank from this old breaker contains 300,000 tons. The wash from this bank and numerous rock banks in the immediate vicinity is large. There is no culm of value.

30. *Philadelphia & Reading Coal & Iron Co. Pine Knot Colliery.*

Location: Heckscherville.
Drainage: Into West Branch of Schuylkill River.

The silt is settled fairly well on a bank, containing 700,000 tons of good material.

The culm has accumulated in two piles. One pile near the breaker contains 150,000 tons of good material. The other pile 1 mile west of the breaker on the south side of the stream contains 200,000 tons. Neither pile has been worked.

31. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: ½ mile east of Pine Knot Colliery.
Drainage: Into West Branch of Schuylkill River.

Two banks, aggregating 600,000 tons, have been accumulated at this locality. One of them is being worked.

32. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: 1 mile east of Heckscherville.
Drainage: Into West Branch of Schuylkill River.

This bank contains 350,000 tons and has been partially worked. The bank is good.

33. *Repplier Coal Company.*

Location: 1½ miles northwest of New Castle.
Drainage: Into Mill Creek.

A silt bank containing 350,000 tons is mixed with ashes. It was produced by the Ellsworth Coal Company and is now abandoned. The culm bank has been practically worked out; only 10,000 tons remain. Much material is being washed down the stream from these two refuse banks.

34. *Butcher Creek Coal Company. Laurel Run Colliery.*

Location: ¼ mile north of New Castle.
Drainage: Into Mill Creek.

The breaker water from this colliery is well settled on a small bank containing 50,000 tons. There is no culm.

35. *Repplier Coal Company. New Castle Colliery.*

Location: New Castle.
Drainage: Into Mill Creek.

The breaker water from this colliery is run out upon a silt bank which is in miserable condition. Most of the silt goes down the creek. An old culm bank containing 50,000 tons originally contained many times this tonnage but has been washed down the creek by floods. There is no culm.

36. *Philadelphia & Reading Coal & Iron Co. Wadesville Breaker.*

Location: Wadesville.
Drainage: Into East Norwegian Creek.

The silt from this breaker is settled in a tank and the solid material is pumped up onto a bank on the hill. The water drains into the creek and carries some silt with it. The bank contains 800,000 tons. A culm bank on the north side of the road has been worked over and no merchantable material is left. The refuse is washing down the stream.

37. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: East Mines (Pottsville Shaft ab).
Drainage: Into Mill Creek.

At this location are one large culm bank and several small ones. These banks aggregate 400,000 tons and have never been worked. They are good. Very small quantities of this material are washing away.

38. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: 1 mile north of Pottsville opposite Pennsylvania Railroad tunnel mouth.
Drainage: Into Mill Creek.

Several small banks are located in the valley of a small stream. These banks aggregate 200,000 tons and contain much good material. They have never been worked. There is some wash from these banks.

39. *Hudson Coal Company. Chamberlain Bank.*

Location: 1 mile northwest of Pottsville.
Drainage: Into West Norwegian Creek.

This bank contains 400,000 tons of very good material. It was being loaded in 1925. Some of the material is being washed down the creek.

40. *Philadelphia & Reading Coal & Iron Co. Thouron Bank.*

Location: 1¼ miles northwest of Pottsville.
Drainage: Into West Norwegian Creek.

This bank contains 50,000 tons of good material. Approximately 60 per cent is coal. It has been partially worked. Some of the material has washed down the stream.

41. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: Oscar Place.
Drainage: Into West Norwegian Creek.

At this location is a 300,000 ton pile of culm from an old abandoned breaker. Another bank containing 200,000 tons was located a short distance down the creek and has been partially worked. These piles are overgrown with grass and small trees and there is very little wash.

42. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: South of Beechwood.
Drainage: Into West Norwegian Creek.

A large accumulation of culm in large and small banks aggregated 1,000,000 tons. Some of these banks have been partially worked. They are of excellent quality. Some of the material is washed into the creek each year.

43. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: At Beechwood shaft.
Drainage: Into West Norwegian Creek.

Several banks in this locality aggregate 2,000,000 tons. They are old and of very fine quality. Grass and small trees are growing on them which prevent washing.

44. *Alliance Coal Company. Old Palmer Colliery.*

Location: Between New Philadelphia and Cumbola.
Drainage: Into Schluykill River.

An old silt bank containing 200,000 tons has never been worked. The culm banks are practically worked out. Probably 150,000 tons remain scattered over the property. Across the river from this old culm bank is another bank containing 75,000 tons which has never been worked. The authors could not trace the ownership. This bank is gradually washing into the river.

45. *St. Clair Coal Company. St. Clair Colliery.*

Location: ½ mile north of St. Clair.
Drainage: Into Mill Creek.

The silt from this colliery is pumped from a settling tank up onto a rock dam. The bank contains 600,000 tons. Some silt goes into the streams. Another bank of stored silt contains 1,000,000 tons. There is no culm.

46. *Philadelphia & Reading Coal & Iron Company. Culm from Old Shaft Colliery.*

Location: On the west side of Mill Creek at St. Clair.
Drainage: Into Mill Creek.

This old bank contains 400,000 tons. It is good and probably contains 60 per cent coal. It has never been worked. Some of the material is washing into the stream.

47. *Philadelphia & Reading Coal & Iron Co. Pine Forest Colliery.*

Location: 1 mile east of St. Clair.
Drainage: Into Mill Creek.

400,000 tons of silt are piled against the hillside. Some of it is washing away. The silt from this breaker is settled in a tank and scraped up the hillside. A culm bank containing 1,000,000 tons is good material and has approximately 60 per cent of coal in it. The breaker now depends upon this bank for its production.

48. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location ½ mile north of Port Carbon.
Drainage: Into Mill Creek.

An old culm bank containing 75,000 tons of good material has never been worked. It is overgrown with grass and small trees.

49. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: On west side of Mill Creek ¼ mile from St. Clair.
Drainage: Into Mill Creek.

An old culm bank containing 75,000 tons has never been worked. It appears to have fairly good quality.

50. *South Penn Collieries Company. Randolph Colliery.*

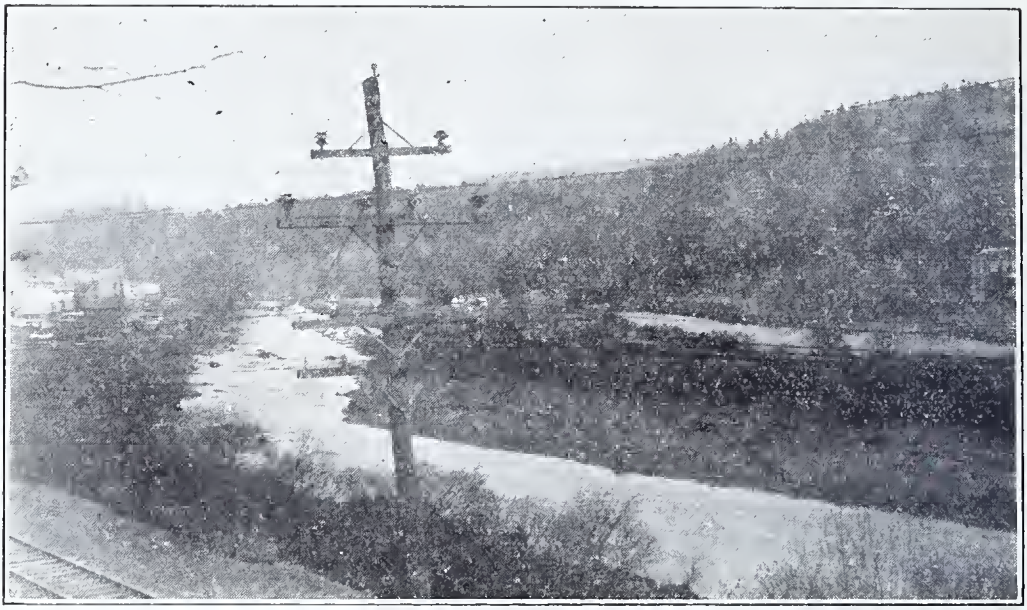
Location: ½ mile east of Palo Alto.
Drainage: Into Mill Creek.

The silt from this breaker is settled on a rock bank. Much of it finally goes into Schuylkill River. 200,000 tons of very rough culm are accumulated at this breaker. An unsuccessful attempt was made to work it.

51. *Frackville Coal Company. Lucanna Colliery.*

Location: ½ mile southwest of Cumbola.
Drainage: Into Schuylkill River.

The silt from this breaker is settled in a rudely constructed dam. The accumulation contains 20,000 tons. Much of the silt goes into Schuylkill River. The culm is all worked over.



A. Schuylkill River at Cumbola.

B. Culm bank at Cumbola.

52. *Philadelphia & Reading Coal & Iron Co. Eagle Hill Colliery.*

Location: 1¼ miles northwest of Cumbola.
Drainage: Into Schuylkill River.

The silt from this breaker is put on a rock pile. Some of it eventually reaches the stream.

A culm pile containing 3,000,000 tons is an accumulation of 80 years. They are washing it into cars and putting it through the breaker. It is a good bank. Another pile containing approximately 10,000,000 tons of silt, culm, and rock may have future value.

PLATE VIII

A. Silt bank on Silver Creek. A perfect settling basin.

B. Silt bank on Silver Creek.

53. *Philadelphia & Reading Coal & Iron Co. Silver Creek Colliery.*

Location: Silver Creek.
Drainage: Into Silver Creek.

The breaker water is settled on an enormous bank which is well dammed up. It contains 1,500,000 tons of silt.

The culm bank at the shaft contains 1,000,000 tons. Much of it has been moved. This bank has a large percentage of domestic sizes in it. It is probably 60 per cent coal. There is some wash from this bank.

54. *Lehigh Coal & Navigation Co. Alliance Colliery.*

Location: Kaska, 1½ miles north of Middleport.
Drainage: Into Schuylkill River.

The breaker water is pumped up on a hillside bank which contains 300,000 tons of silt. The drainage water goes into the creek and some silt goes with it. A bank in the valley contains 300,000 tons. It is 12 feet thick. Some of it is being loaded for boiler fuel. There has been much wash from this bank.

The culm accumulation has been practically worked out. Approximately 100,000 tons of material are scattered over the hillside.

55. *Culm (owner not known).*

Location: ½ mile north of Middleport.
Drainage: Into Schuylkill River.

This bank is evidently from an old breaker. It is in the stream bottom and has been there for years. It contains 75,000 tons. The creek coming into Middleport from the north is filled with this silt and culm.

56. *Hazle Brook Coal Company. Mary D Colliery.*

Location: On Locust Mountain, 1 mile north of Tuscarora.
Drainage: Into Schuylkill River.

The breaker water is settled in a tank and the silt is shipped. 75,000 tons is heaped into a pile. The drainage water goes into Schuylkill River and contains some silt. There is no culm.

57. *Gorman & Campion Coal Company. Bell Colliery.*

Location: ½ mile west of Tuscarora.
Drainage: Into Schuylkill River.

The water from this breaker is fairly well settled behind a silt dam. The drainage water goes into Schuylkill River and carries with it much silt. A silt dump at this breaker contains 100,000 tons, and 50,000 tons have accumulated behind the silt dam.

The culm bank which contains much rock was unsuccessfully worked. It contains 200,000 tons.

PLATE IX

A. Silt bank at Mary D Colliery, Hazle Brook Coal Co.

B. Silt storage at Mary D Colliery, Hazle Brook Coal Co. The silt is transported by scraper line.

58. *Philadelphia & Reading Coal & Iron Co. Culm (probably from old Tucker slope).*

Location: Tuscarora.
Drainage: Into Schuylkill River.

This bank contains 50,000 tons and has never been worked. Some of it is washing away.

59. *Philadelphia & Reading Coal & Iron Co. Buckville Colliery*

Location: 1 mile northeast of Tuscarora.
Drainage: Into Schuylkill River.

A culm pile containing 1,000,000 tons of good material is being loaded and sent to Reesedale breaker. Some of this material is washing into the stream. The colliery is abandoned.

60. *Philadelphia & Reading Coal & Iron Co. Reesedale Colliery.*

Location: 1½ miles northeast of Tuscarora.
Drainage: Into Schuylkill River.

The silt from this breaker is settled in a tank and hauled up the mountainside to a well constructed bank. This bank contains 400,000 tons. Very little goes into the stream.

An old culm bank has been worked intermittently. 200,000 tons remain. Some of this material has been washing down the hillside.

61. *Philadelphia & Reading Coal & Iron Co. Newkirk Colliery*

Location: On Schuylkill River east of Tuscarora.
Drainage: Into Schuylkill River.

Much material from this old dry breaker has accumulated at this locality. One bank containing 800,000 tons has never been worked. It contains approximately 60 per cent coal and some of it is large sizes. This bank is located on the north side of the road. Another bank on the south side of the road is now being worked. It contains 300,000 tons. There has been much wash from these two old banks. This colliery is abandoned.

62. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: High Mines, 1 mile north of Tamaqua.
Drainage: Into Little Schuylkill River.

A scattered deposit of culm containing 500,000 tons is located on the hillside. This material has never been worked and much of it is washing into the creek.

63. *Lehigh Coal & Navigation Co. Culm.*

Location: On the east side of creek, ½ mile north of Tamaqua.
Drainage: Into Little Schuylkill River.

This bank contains 50,000 tons. It is being loaded and run through Tamaqua breaker.

64. *Kresge Washery.*

Location: 3 miles south of Tamaqua.
Drainage: Into Little Schuylkill River.

This washery is working culm from old Donaldson Colliery of the Philadelphia & Reading Coal & Iron Company. The culm was trammed down the river because there was no room for it at Tamaqua. These accumulations contain 500,000 tons of good material.

65. *Philadelphia & Reading Coal & Iron Co. Culm.*

Location: $\frac{1}{4}$ mile south of Tamaqua on the east hillside.
Drainage: Into Little Schuylkill River.

300,000 tons of culm are scattered on the hillside and are gradually washing into the river. This accumulation has never been worked.

66. *East Lehigh Coal Company. East Lehigh Colliery (ab)*

Location: $\frac{1}{4}$ mile south of Tamaqua.
Drainage: Into Little Schuylkill River.

There are 200,000 tons of culm of doubtful value at this old breaker site. It is gradually washing into the river.

67. *Lehigh Coal & Navigation Co. Tamaqua Colliery.*

Location: 1 mile east of Tamaqua.
Drainage: Into Panther Creek.

The silt from this breaker is settled in a tank and is scraped up onto a well kept bank containing 400,000 tons. Some silt goes into the creek. A silt bank in the valley below the breaker is 6 feet thick and contains 200,000 tons. Some of it is washing into Panther Creek. Another bank in the Panther Creek Valley came from old No. 13 Colliery. It has been partly worked over. It contains 500,000 tons. A washery was erected here in 1923 but it is now closed down. This culm is scattered for half a mile along Panther Creek and much of it is being washed away.

67A. *Lehigh Coal & Navigation Co. Greenwood Colliery.*

Location: 1 mile west of Coaldale.
Drainage: Into Panther Creek.

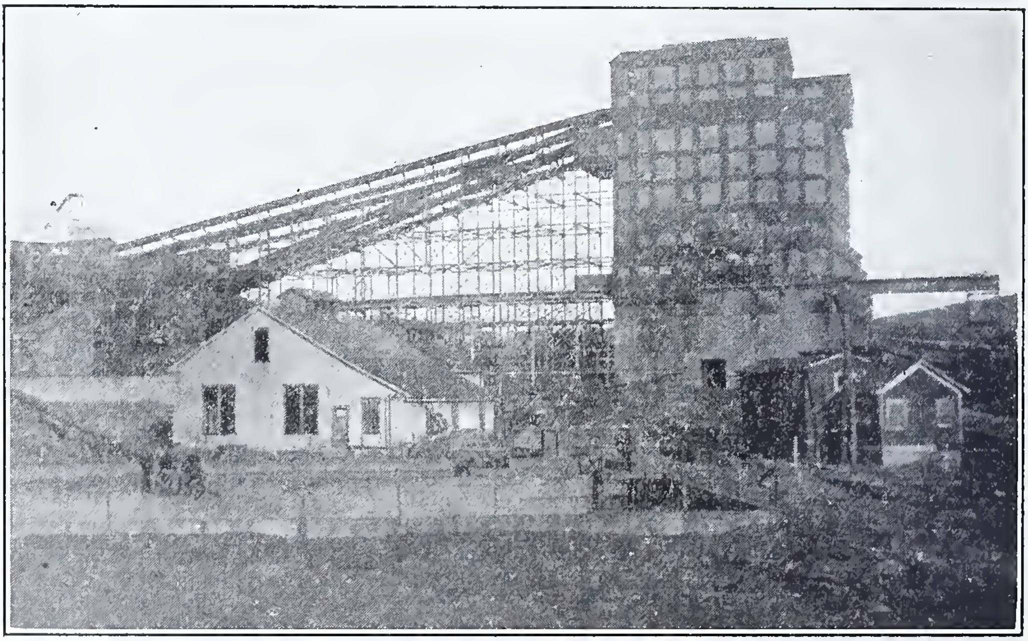
The breaker water from this colliery is run into a settling tank and rude elevators take the silt to a bank. Very little of the silt is getting into the stream. The bank contains 400,000 tons.

68. *Lehigh Coal & Navigation Co. Coaldale Colliery.*

Location: Coaldale.
Drainage: Into Panther Creek.

The water from this breaker is settled in a tank and the silt pumped up onto a bank. Very little goes into the stream. Numerous silt and culm banks here belonging to this colliery aggregate 1,000,000 tons. Some of the material is washing into Panther Creek.

A. Coaldale Breaker silt bank.



B. Settling tank at Lansford colliery.

69. *Lehigh Coal & Navigation Co. Lansford Colliery.*

Location: Lansford.
Drainage: Into Panther Creek.

The breaker water from this colliery is settled in a tank and the silt is scraped up onto a silt bank. Very little solid discharge goes into Panther Creek. A silt bank at the new breaker contains 300, 000 tons. A culm bank near the new breaker contains 500,000 tons. Part of it has been worked for boiler fuel.

70. *Lehigh Coal & Navigation Co. Nesquehoning Colliery.*

Location: Nesquehoning.
Drainage: Into Nesquehoning Creek.

The breaker water from this colliery is well settled on a silt bank which contains 1,200,000 tons. The drainage water goes into the creek and is fairly clear.

A culm bank which was originally very large has been worked intermittently for 10 years. It contains 250,000 tons. Some of the refuse material from this colliery is washing into Nesquehoning Creek.

Stream Conditions in the Western Middle Field

The Western Middle Coal Field is drained by three principal streams, Mahanoy Creek, Shamokin Creek, and Zerbe Run.

Zerbe Run has its headwaters at Kulps. It drains the area between Little and Mahanoy Mountains and flows southwestward. Two active collieries are located on this creek, the North Franklin Colliery of the Philadelphia & Reading Coal Company, and Kathryn Colliery of South Penn Collieries Company. In addition to current discharge into the stream two large culm banks are being eroded at Trevorton. The water of Zerbe Run is black and carries much solids in solution. However it does very little damage to the farms through which it flows. The silt bank at Kathryn Colliery is washed by Zerbe Run when the water is high. The breaker water from North Franklin Colliery is fairly well settled, but some solids go into the stream.

Mahanoy Creek first accumulates its water in the mountainous region in the vicinity of Delno. It flows southwestward through Mahanoy City, Girardville, Ashland, and leaves the Western Middle Field in the vicinity of Gordon.

At Gordon the creek has deposited much silt and flows over the entire valley which is comparatively wide. The vegetation has been killed by this silt deposition. The valley bottom between Gordon and Ashland is almost completely filled with silt. At Ashland the gradient of the stream is greater where it cuts a gap through the mountains. At this point the silt banks rise almost directly out of the stream and furnish an almost inexhaustible supply of material to be washed away.

Mine Run flows into Mahanoy Creek 1 mile east of Ashland. This run carries the silt from two collieries and the water is black. Some accumulation of silt is seen eastward through the town of Girardville. Provision has been made here for keeping the creek within its banks. Just east of Girardville, Shenandoah Creek enters Mahanoy Creek. The water of Shenandoah Creek is very black and contains large quantities of solids. It drains the waste material from nine large collieries. The valley of Shamokin Creek is narrow between Girardville and Lost Creek. At Lost Creek it broadens out and thousands of tons of silt and culm have been deposited in it. The enormous banks of the Packer colliery are located in the stream valley and are continuously washed by the water. The town of Shenandoah has very little difficulty with the stream, although it deposits much silt.

PLATE XI

A. Looking up Mahanoy Creek near its mouth. The water is always black when the mines are working.

B. Looking down Mahanoy Creek near its mouth.

The valley of Mahanoy Creek is comparatively narrow between Girardville and Mahanoy Plane. Some accumulation of silt is noticeable but the stream keeps its course clear. The largest accumulation of silt in the anthracite region is in the valley of Mahanoy Creek between Mahanoy Plane and Mahanoy City. It represents the accumulation of many years and is the aggregate waste material from approximately two dozen collieries. Most of

these collieries did not make an attempt to save the fine material until comparatively recently. The valley of Mahanoy Creek is only a quarter of a mile wide and storage room for waste material is at a premium. This is an area of steep pitch mining and enormous quantities of waste material have been brought to the surface. These banks, scattered along the valley sides, offer a great opportunity for erosion and wash. Mahanoy Creek flows upon a bed of silt as much as 40 feet thick, and meanders between culm banks many of which contain over a million tons of material. Railroads which run through the valley have been raised as the silt accumulates It has been necessary to keep the channel open by dredging. This creek valley is representative of anthracite mining. It is a concrete picture of the difficulties encountered in producing anthracite.

Some of the towns along Mahanoy Creek have great difficulty in keeping the creek within bounds during flood periods. The deposition of silt fills the sewers and the water backs up into the houses. The towns are built in the narrow flood plain of the stream and nothing less could be expected. Eventually the towns in the valley between Girardville and Mahanoy City will be abandoned and the entire valley will be stripped and coal recovered from the pillars. In this locality the Mammoth bed is very thick, in some places 112 feet, of which 62 feet or more is marketable coal. The damage which the silt in this valley is doing is only temporary and in a way cannot be prevented when so much mining is done in such a restricted area.

Shamokin Creek heads in the mountains in the vicinity of Centralia. It flows northwestward through Mt. Carmel, Shamokin, and enters the Susquehanna at Sunbury. The entire valley bottom is covered with silt. From Sunbury to Little Mountain Gap the flood plain of Shamokin Creek is wide, and thousands of tons of impure silt have been deposited. Some of this washes down the creek each year into the Susquehanna. This accumulation has done little or no damage.

The first pollution of Shamokin Creek takes place on the hillside of Big Mountain gap where the Cameron Colliery of the Susquehanna Collieries Company is located. These banks are gradually washing into the river. Most of them have been removed now and less material is being washed away. Small tributaries entering Shamokin Creek in the town of Shamokin contribute their share of solid materials. The creek water is black. Shamokin Creek is lined with stone and concrete walls practically all the way through the town and the current is rapid enough to keep the channel clean. Between Shamokin and Mt. Carmel numerous other collieries add silt to the creek but the current is fast enough to keep the channel open. The creek valley is narrow between Shamokin and a small settlement called Enterprise. No damage is done by silt between these two points. Coal, Quaker, Buck, and Carbon runs have contributed silt to the creek. The flood plain of Shamokin Creek widens 1½ miles west of Mt. Carmel. The gradient is less and large quantities of silt have been deposited. This location has been the scene of dredging operations for many years. A flat flood plain just west of the town of Mt. Carmel contains thousands of tons of silt. This flood plain is not as large as it was formerly because some of the

A. Shamokin Creek, six miles from its mouth. Silt bars are prevalent and the banks are mucky.

B. Shamokin Creek near its mouth. Silt is deposited in each bend of the creek.

material has been removed. The flood plain has been built up gradually until it has been necessary to take the creek through it in a flume. This condition has caused the city of Mt. Carmel much difficulty, but the condition is well controlled. The headwaters of Shamokin Creek are a source of much pollution.

The discharge of silt into Shamokin Creek is much less than it has been in former years. Most of the companies realize that these fine sizes have a potential value and are making concentrated efforts to save most of the tonnage. The creek will gradually clean

its channel and within a few years practically all of the large deposits along its banks will disappear. In fact, a great change has been noticed in the size of these deposits within the last five years. Many of the old deposits contain large proportions of domestic-size coal. These deposits have been practically worked over and all of the material which goes down the stream is of small size.

Silt and Culm Conditions at Collieries in the Western Middle Field

71. *South Penn Collieries Co. Kathryn Colliery.*

Location: On Zerbe Run, 3½ miles southwest of Trevorton.
Drainage: Into Zerbe Run.

This breaker is settling the water on an improvised silt bank, the base of which is washed by Zerbe Run. The bank is seriously eroded each time Zerbe Run rises. The silt is fairly well settled and the bank contains 40,000 tons. There is no culm.

72. *Philadelphia & Reading Coal & Iron Co. North Franklin Colliery.*

Location: ¼ mile south of the west end of Trevorton.
Drainage: Into Zerbe Run.

The silt from this breaker is collected on a bank on a hillside above the breaker. The breaker water is first settled in a tank and the coal is pumped up onto the bank. Some silt has been loaded out. This bank washes and some of the silt goes into the stream. There are 1,500,000 tons in the accumulation.

A culm bank in the creek bottom at the west end of Trevorton contains 1,000,000 tons. It is probably 60 per cent coal and contains some large sizes. This bank is gradually eroding.

73. *Susquehanna Collieries Co. Cameron Colliery.*

Location: On the east hillside of the gorge 1 mile northwest of Shamokin.
Drainage: Into Shamokin Creek.

No silt is collected at this colliery. All of the breaker water goes directly into the creek.

The remains of an old culm bank on the steep hillside are gradually washing down the hillside into a creek. There are probably 50,000 tons of scattered culm.

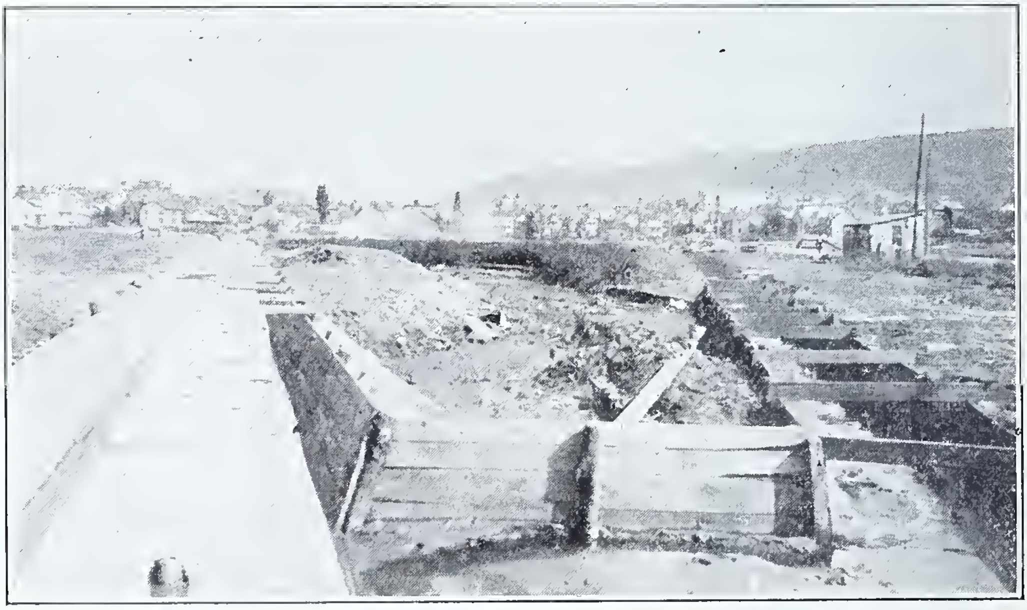
74. *Shamokin Coal Company. Shamokin Colliery.*

Location: On Carbon Run at the south end of Shamokin.
Drainage: Into Carbon Run.

This is a rejuvenated operation and the culm is from an old breaker. There is no separate bank for the silt; what little there is has been run out on the culm bank. No silt or culm is being produced now. The old culm bank has been removed, but 175,000 tons remain scattered over the property. It contains approximately 50 per cent coal. Some of this material is washing into the creek.

PLATE XIII

A. Quaker Run near Shamokin.



B. Flumes carrying Shamokin Creek through the valley west of Mount Carmel. These flumes concentrate the water and the creek keeps its artificial channel clean.

75. *Philadelphia & Reading Coal & Iron Co. Bear Valley Colliery.*

Location: 2 miles southwest of Shamokin.
Drainage: Into Carbon Run.

Several piles of silt from this breaker are accumulated in the valley ¼ mile east of the colliery. There is a bank below the breaker which is forming from the accumulation from a settling tank. The silt is mixed with slate and rock and its recoverable value is partially destroyed. More care could be taken at this colliery in the settling of the silt. Much of it goes into the stream. The accumulation of silt at this colliery is 110,000 tons, and culm 500,000 tons.

76. *Philadelphia & Reading Coal & Iron Co. Burnside Colliery.*

Location: Burnside, 1¼ miles south of Shamokin.
Drainage: Into Carbon Run.

There is a settling tank at this colliery and the silt is pumped up the hill to a bank containing 750,000 tons. The settling tank at this breaker overflows and some of the material goes into the creek. The silt bank washes and some of the silt is lost. An old culm bank containing 500,000 tons is located on the east side of the road. This appears to be a good bank. Some of this bank is washing into the creek.

77-78. *Philadelphia & Reading Coal & Iron Co. Henry Clay Colliery.*

Location: 1 mile south of Shamokin.
Drainage: Quaker Run.

The silt from this breaker is pumped out of the settling tank onto a bank on a hillside above the breaker. The settling tank is not watched carefully and it often overflows and much fine-sized material reaches the stream. The silt bank also washes.

The culm is accumulated in two piles; one at the breaker contains 500,000 tons, and another around the hill from the breaker contains 500,000 tons. An additional culm pile some distance from the breaker contains 100,000 tons. It has some ashes in it but its quality is fair. This bank is also eroding.

79. *Puritan Coal Company. Buck Ridge Colliery.*

Location: 1 mile east of Shamokin.
Drainage: Into Coal Run.

The silt from this breaker is settled in the creek bottom. It is gradually washing away and is not well dammed up. The water from the breaker goes directly out onto the bank and runs across it without much settling. There are 75,000 tons of silt in the stream valley. There is no culm.

80. *Philadelphia & Reading Coal & Iron Co. Culm (Old Greenback).*

Location: West side of creek ½ mile south of Ranshaw.
Drainage: Into Quaker Run.

This bank is from old Greenback Colliery which is now abandoned. It has excellent quality and is loaded into freight cars and shipped to Ashland for preparation. It contains 500,000 tons. Precaution has been taken to keep the bank from washing.

81. *Excelsior Coal Company. Carbon Colliery.*

Location: 1 mile south of Ranshaw.
Drainage: Into Shamokin Creek.

The silt from this breaker is not saved. It goes directly into the creek.

Culm has been accumulated in three banks aggregating 1,000,000 tons. These banks are now being worked intermittently. They are being washed by heavy rains with the consequent loss of material.

82. *Northumberland Mining Co. Enterprise Colliery.*

Location: 1½ miles south of Ranshaw.
Drainage: Into Shamokin Creek.

The silt from this colliery is settled on two banks. The water runs across these banks and into the stream without complete settling. The banks are not properly protected. These two banks contain an aggregate of 800,000 tons.

A very good old bank of culm contains 400,000 tons. Part of it has been worked over.

83. *Shipman Coal Company. Glenbrook Colliery.*

Location: 1 mile north of Ranshaw.
Drainage: Into Coal Run.

The breaker water from this colliery passes over a badly kept silt bank. Practically all of the silt goes into the stream. The bank is small and contains approximately 10,000 tons. There is no culm.

84. *Susquehanna Collieries Company. Washery.*

Location: 1½ miles northeast of Shamokin.
Drainage: Into Coal Run.

This colliery is washing a leased culm bank. This was once a large bank but only 50,000 tons remain. It is good culm. The residue after washing is not stored and most of it goes into the creek.

85. *Susquehanna Collieries Company. Luke Fidler Colliery.*

Location: 1 mile east of Shamokin on the State highway.
Drainage: Into Coal Run.

The silt from this breaker is accumulated on two large banks. The settling is done fairly well although some silt goes into the stream. These banks contain an aggregate of 800,000 tons. There is no culm.

86. *Susquehanna Collieries Company. Scott Colliery.*

Location: Kulpmont.
Drainage: Into Quaker Run.

The silt from this colliery is very well settled in a tank and is taken up by scraper line to a bank. Very little gets away to the stream. The bank contains 1,500,000 tons. There is no culm.

87. *Colonial Colliery Company. Greenough Colliery.*

Location: ½ mile northeast of Kulpmont.
Drainage: Into Quaker Run.

The silt from this breaker is settled in a tank and is scraped up onto a bank. The operation is efficient and very little silt is going into the creek. This bank contains 2,000,000 tons. The breaker has no culm bank. The rock pile, which is rather large, may contain some good coal.

88. *Colonial Colliery Company. Natalie Colliery.*

Location: 3 miles northwest of Mount Carmel, and 1½ miles southeast of Bear Gap settlement.
Drainage: Into Coal Run.

The silt from this colliery is efficiently settled in a tank and scraped up onto a bank. Very little silt washes away. The bank contains 500,000 tons.

A large bank of culm containing 500,000 tons is probably 40 per cent coal.

89. *Susquehanna Collieries Company. Pennsylvania Colliery.*

Location: Strong post office, 1½ miles west of Mount Carmel on the State highway.
Drainage: Into Quaker Run.

This breaker has a settling tank and the silt is scraped up onto two large banks aggregating 1,000,000 tons. Very little silt goes to waste. There is no culm.

90. *Susquehanna Collieries Company. Richards Colliery.*

Location: ¾ mile north of Mount Carmel.
Drainage: Into Shamokin Creek.

This breaker has a settling tank and the silt is scraped up onto the bank. Very little is wasted. This bank contains 500,000 tons. There is no culm.

91. *Wentz & Company. Midvalley Colliery.*

Location: Wilburton, 2 miles northeast of Mt. Carmel.
Drainage: Into Shamokin Creek.

The silt from this breaker is settled in the creek bottom. A large quantity goes down the stream. This bank contains 2,000,000 tons. There is no culm.

92. *Lehigh Valley Coal Company. Sayre Colliery.*

Location: ¼ mile east of Mt. Carmel.
Drainage: Into Shamokin Creek.

This breaker has a 90 ft. Dorr thickener and the silt is scraped up onto a large bank containing 1,000,000 tons. Very little of the silt is getting away.

A fine large bank of culm containing 1,000,000 tons is now being worked. This bank probably contains 70 per cent coal.

93. *Philadelphia & Reading Coal & Iron Co. Reliance Colliery.*

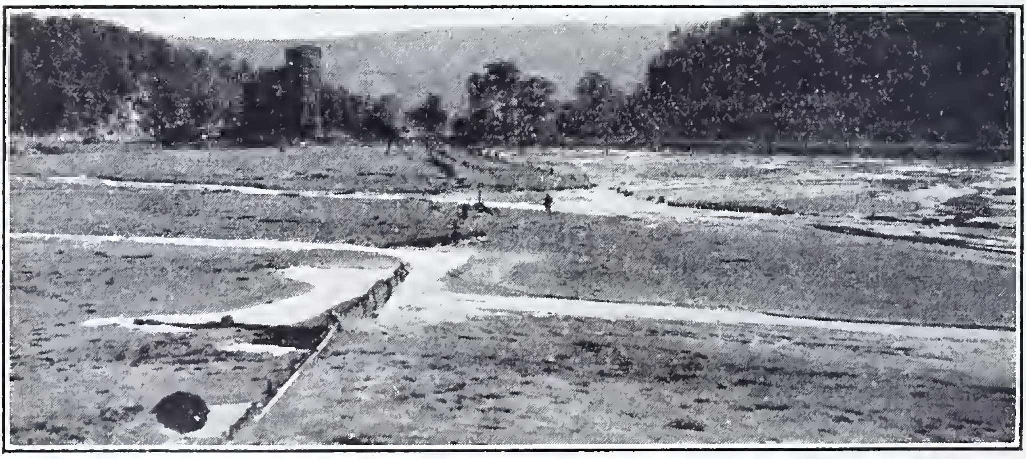
Location: At the east end of Mt. Carmel.
Drainage: Into Shamokin Creek.

The water from this breaker is settled by running over a well kept bank, but some of the silt goes into the stream.

One large culm bank containing 1,000,000 tons is of good quality. Another bank, a mixture of rock and culm, contains 750,000 tons. Its value is uncertain.

A. Stream conditions at Mount Carmel.

B. Stream conditions at Mount Carmel. Much of the silt and culm has been removed.



C. Shamokin Creek west of Mount Carmel. The washery in the background was used to recover creek coal.

94. *Philadelphia & Reading Coal & Iron Co. Alaska Colliery.*

Location: Alaska.
Drainage: Into Shamokin Creek.

The silt from this breaker was settled in a tank and scraped up onto a bank. Some of it was used inside and some of it went into the creek. The bank contains 750,000 tons. This breaker is now burned down.

The culm bank is on fire and its value is small.

95. *Philadelphia & Reading Coal & Iron Co. Locust Gap Colliery.*

Location: Locust Gap.
Drainage: Into Shamokin Creek.

This breaker has a settling tank and a scraper line. Very little solid material goes into the stream. There are two banks, a large one containing 2,000,000 tons, and another containing 500,000 tons. The culm is contained in two banks. One located $\frac{1}{4}$ mile north of the breaker contains 1,200,000 tons. It is a fine bank and is probably 65 per cent coal. Another bank is located at the breaker. It is also good and contains 1,000,000 tons of material.

96. *Lehigh Valley Coal Company. Sioux No. 1 Colliery (ab)*

Location: At northwest city line of Mt. Carmel.
Drainage: Into Shamokin Creek.

This breaker has been dismantled. An old culm bank containing 2,000,000 tons has never been worked. It is a good bank. Very little of it is washing away.

97. *Philadelphia & Reading Coal & Iron Co. Keystone Colliery*

Location: Locust Dale.
Drainage: Into Big Run.

A large bank of culm on a hillside south of Locust Dale contains 1,000,000 tons. It is an excellent bank and has never been worked. Some of it is washing into the stream. Colliery abandoned.

98. *Philadelphia & Reading Coal & Iron Co. Potts Colliery.*

Location: Locust Dale.
Drainage: Into Big Run.

This colliery has a settling tank and the silt is pumped onto a bank on the mountain side above the breaker. This bank contains 2,000,000 tons. Very little silt is lost.

The culm is contained in three piles aggregating 2,500,000 tons. It is good material and has never been worked.

99. *Philadelphia & Reading Coal & Iron Co. Merriam Colliery*

Location: 1½ miles south of Mount Carmel.
Drainage: Into Big Run.

This colliery is abandoned.

The silt from this old breaker is gradually washing away. The bank is not protected. It contains 500,000 tons.

Some culm has been shipped from this breaker; 2,000,000 tons remain scattered over the ground.

100. *Philadelphia & Reading Coal & Iron Co. Old Johns Colliery*

Location: 2 miles southwest of Mount Carmel and ½ mile east of Locust Gap.
Drainage: Into Shamokin Creek.

The material from this bank is gradually washing into the stream. The bank contains 1,000,000 tons. It has been worked but little.

This colliery is abandoned.

101. *Lehigh Valley Coal Company. Centralia Colliery.*

Location: ¼ mile east of Centralia.
Drainage: Into Mine Run.

The silt from this breaker was formerly settled in a tank and scraped up onto a bank; now most of it settles in a dam below the old silt bank. Some of it goes into the creek. An estimate of the silt in those banks was placed at 2,000,000 tons.

Several banks of culm aggregating 1,000,000 tons are scattered on the breaker property and in the valley below. Much of this material is washing into the stream.

102. *Philadelphia & Reading Coal & Iron Co. Bast Colliery.*

Location: At Big Mine Run, 1 mile northeast of Ashland.
Drainage: Into Mine Run.

This colliery has a settling tank and a scraper line. The silt is scraped to a bank containing 1,250,000 tons. Some of the silt goes into the stream. This property has several good old culm banks aggregating 1,000,000 tons.

103. *Philadelphia & Reading Coal & Iron Co. Old Tunnel Colliery*

Location: East end of Ashland.
Drainage: Into Mahanoy Creek.

This colliery is abandoned.

A silt bank containing 300,000 tons is gradually washing into the creek. A good culm bank containing 250,000 tons is now being worked. It has been washing into the stream.

104. *Philadelphia & Reading Coal & Iron Co. Preston No. 3 Colliery (ab)*

Location: West end of Girardville.
Drainage: Into Mahanoy Creek.

The silt bank from this old breaker is located on the north side of the road at the west end of Girardville. It contains 1,000,000 tons. Some of it is washing into the creek.

An old culm bank containing 1,500,000 tons is excellent. It has never been worked.

105. *Wentz & Company. Girard Colliery.*

Location: ½ mile east of Girardville.
Drainage: Into Mahanoy Creek.

This colliery has a settling tank and a scraper line. The silt is scraped up onto a bank containing 400,000 tons. This bank has been partially worked. Some of the silt from this colliery goes into the stream. Several small piles of culm are lying about the property and aggregate 400,000 tons. Heavy rains are gradually washing them away.

106. *Wentz & Company. Girard Mammoth Colliery.*

Location: Raven Run, 2 miles northeast of Girardville.
Drainage: Into Shenandoah Creek.

The silt from this colliery is settled and scraped up to a well kept bank. Very little gets away. The bank contains 2,000,000 tons.

A culm bank containing 500,000 tons of good material has not been worked. This bank is being eroded a little.

107. *Philadelphia & Reading Coal & Iron Co. Hammond Colliery.*

Location: Lost Creek, 1½ miles northeast of Girardville.
Drainage: Into Shenandoah Creek.

This colliery has a settling tank and the silt is mixed with the culm on a large bank containing 2,000,000 tons. Some of the silt goes into the creek. A large culm bank on a hillside contains 500,000 tons. It is being washed considerably by heavy rains.

108. *Lehigh Valley Coal Co. Packer No. 5 Colliery.*

Location: ½ mile northeast of Girardville.
Drainage: Into Shenandoah Creek.

The coal from this colliery goes to Packer No. 4 for preparation. There is no production of silt now. There is an accumulation of 2,000,000 tons in the creek valley. It is well protected but is in an unfortunate position. Some of it goes into the streams. A culm bank containing 1,500,000 tons is composed mostly of the so-called bony coal of former years. This coal is of value now.

109. *Philadelphia & Reading Coal & Iron Co. Culm and silt.*

Location: 1½ miles west of Mahanoy Plane.
Drainage: Into Mahanoy Creek.

A culm bank from old West Bear Ridge colliery is gradually washing into the creek. Its value is slight.

A silt bank containing 1,200,000 tons of good material is located in the creek valley and is gradually washing away.

110. *Lehigh Valley Coal Company. Packer Nos. 2, 3, & 4.*

Location: ¾ mile west of Shenandoah.
Drainage: Into Shenandoah Creek.

The silt from this breaker is settled on large banks in the creek valley containing an aggregate of 5,000,000 tons. The creek is rapidly eating into the base of both the silt and culm banks.

Enormous banks of good culm in the creek valley contain 3,000,000 tons of material. These piles are being washed by Shenandoah Creek.

111. *Susquehanna Collieries Company. William Penn Colliery.*

Location: William Penn, 1 mile west of Shenandoah.
Drainage: Into Shenandoah Creek.

One large silt bank contains 400,000 tons. There is nothing larger than No. 3 buckwheat in it. The water is fairly well settled, but some silt goes into the stream.

The old culm banks are practically exhausted. One culm bank of 50,000 tons has been practically worked over.

112. *Dodson Coal Company. Locust Mountain Colliery.*

Location: ½ mile west of Shenandoah.
Drainage: Into Shenandoah Creek.

The water from this breaker is settled on a well-dammed-up bank containing 400,000 tons. A settling tank partially dewaters the silt. The water drains into Shenandoah Creek and contains some silt.

A culm pile containing 800,000 tons is now being worked. Some of the pile is being covered by rock.

113. *Philadelphia & Reading Coal & Iron Co. West Shenandoah Colliery.*

Location: West end of Shenandoah.
Drainage: Into Shenandoah Creek.

The silt from this breaker is settled and then pumped up over the rock pile. Much of it goes into the creek. Practically all of the culm piles have been worked over. Approximately 50,000 tons remain unworked. About 300,000 tons of worked over material will be valuable.

114. *Philadelphia & Reading Coal & Iron Co. Shenandoah City Colliery.*

Location: At southeast Shenandoah City line.
Drainage: Into Shenandoah Creek.

The silt is settled in a tank and pumped up onto an old culm bank which has not been worked. The bank contains 500,000 tons of material.

115. *Harleigh-Brookwood Coal Company. Kehley Run Colliery.*

Location: 1½ miles northeast of Shenandoah City.
Drainage: Into Shenandoah Creek.

The breaker water goes directly into the silt bank. It is not well settled and some of it goes into the creek. The bank contains 50,000 tons.

An old culm bank which was originally enormous has been worked over and only 10,000 tons of culm remain. Some of the refuse is washing into the creek.

116. *Philadelphia & Reading Coal & Iron Co. Indian Ridge Colliery (ab).*

Location: ½ mile east of Shenandoah in the valley of Shenandoah Creek.
Drainage: Into Shenandoah Creek.

A culm bank which originally contained an enormous tonnage is now being worked. There are 2,000,000 tons of material in this fine bank. It contains 60 to 70 per cent coal with some large sizes. There is no silt at this location.

117. *Harleigh-Brookwood Coal Company. Lawrence Colliery.*

Location: ¼ mile southeast of Mahanoy Plane.
Drainage: Into Mahanoy Creek.

This breaker has a settling tank for the breaker water and the silt is scraped up onto a bank by a scraper line. There are 1,000,000 tons of silt in the pile. Some of it is washing down the hill. Several old culm piles aggregating 3,000,000 tons have a very small percentage of valuable material in them. These banks are also gradually eroding.

118. *Harleigh-Brookwood Coal Company. Stanton Colliery.*

Location: Mahanoy Plane, on the north side of Mahanoy Creek.
Drainage: Into Mahanoy Creek.

The silt from this breaker is settled in the creek valley. Much of it washes down the stream. The culm and silt are mixed in a large bank which contains 2,500,000 tons.

119. *Philadelphia & Reading Coal & Iron Co. Draper Colliery (ab)*

Location: West end of Gilberton on the south side of the creek.
Drainage: Into Mahanoy Creek.

No silt is being produced at this breaker. 500,000 tons of this material has been settled between rock banks in the creek valley. These banks are gradually washing into the creek. There is no culm.

120. *Philadelphia & Reading Coal & Iron Co. Gilberton Colliery.*

Location: Gilberton, on the north side of the creek.
Drainage: Into Mahanoy Creek.

This breaker has a settling tank. The silt is scraped up onto a pile by a scraper line. There are 8,000,000 tons of mixed culm and silt in a large pile in the creek bottom. During high water much of this material is washed down the creek.

121. *Philadelphia & Reading Coal & Iron Co. Boston Run Colliery (ab).*

Location: Boston Run.
Drainage: Into Boston Run.

The silt from this breaker is settled in the creek valley. It is gradually washing into the stream. A dredge is operating here to keep the channel open.

One small culm bank in the creek valley, containing 25,000 tons has not been worked. It also is gradually washing away.

122. *Philadelphia & Reading Coal & Iron Co. St. Nicholas Colliery.*

Location: St. Nicholas.
Drainage: Into Mahanoy Creek.

The silt from this breaker is settled in a tank and scraped up on the hill above the breaker. The bank contains 500,000 tons. Very little silt goes into the stream except through the weathering of the bank. There is no culm.

123. *Philadelphia & Reading Coal & Iron Co. Maple Hill Colliery.*

Location: ¼ mile north of St. Nicholas.
Drainage: Into Mahanoy Creek.

The silt from this breaker is taken from the settling tanks by a scraper line onto a bank on a hillside. The water is well settled, and very little silt goes into the creek. The silt is mixed with culm in banks aggregating 5,000,000 tons. Some of the culm has been worked over.

A. Silt in Mahanoy Creek at Draper Colliery.

B. View up Mahanoy Creek from the Frackville road.

C. Mahanoy Creek near Gilberton. The channel is dredged to keep it clean.

124. *Philadelphia & Reading Coal & Iron Co. Ellangowan Colliery.*

Location: ¾ mile north of St. Nicholas (This description includes the accumulations from Knickerbocker Colliery).
Drainage: Into Mahanoy Creek.

The silt from this breaker is settled in a tank and taken up onto a bank of mixed culm and silt containing 1,000,000 tons. Very little of this material is washing into the creek. The water is well settled.

125. *Madeira-Hill Coal Company. Morea Colliery.*

Location: Morea.
Drainage: Into Mill Creek.

The silt from this breaker is settled in a Dorr thickener but some of it finds its way into Mill Run. The silt is scraped onto a rock bank. It is impossible to estimate the quantity. A culm bank which has never been worked contains 400,000 tons of good material. Some of the current silt is sold to the New Jersey Zinc Company.

126. *Madeira-Hill Coal Company (Thomas Coal Co.) New Boston Colliery.*

Location: New Boston.
Drainage: Into Mill Creek.

The old breaker is torn down and the coal is now being prepared at Morea. An old silt bank containing 100,000 tons is located in the creek valley. Some of it is washing away. A culm bank containing 400,000 tons is good and has never been worked.

127. *Philadelphia & Reading Coal & Iron Co. Tunnel Ridge Colliery.*

Location: West end of Mahanoy City.
Drainage: Into Mahanoy Creek.

The water from this breaker is settled but much fine material goes into Mahanoy Creek. The silt is contained in two banks on the south side of the creek. One contains 200,000 tons and the other 400,000 tons.

The culm has been accumulated in two banks. One on the north side of the creek contains 600,000 tons. The bank on the south side of the creek contains 700,000 tons.

128. *Philadelphia & Reading Coal & Iron Co. Mahanoy City and North Mahanoy Collieries.*

Location: ¼ mile north of Mahanoy City.
Drainage: Into Mahanoy Creek.

The silt bank from this breaker is on the east side of the road. It contains 600,000 tons. The water from this breaker is settled in a

tank and a scraper line takes the silt to a bank. The water is fairly well settled but some fine material goes into the stream.

One unworked culm pile contains 600,000 tons. Another culm pile which has been worked over but has much fine-sized coal in it contains 500,000 tons. A culm bank opposite North Mahanoy breaker is in litigation between the Lehigh Valley Coal Company and the Philadelphia & Reading Coal & Iron Co. It has not been worked and is of excellent quality. It contains 600,000 tons. The aggregate tonnage of all of these banks is 1,700,000 tons.

129. *Lehigh Valleg Coal Company. Glendon Colliery. (ab)*

Location: East end of Mahanoy City.
Drainage: Into Mahanoy Creek.

A culm pile on the site of this old breaker is being worked and shipped to Springdale washery. Approximately 500,000 tons of material remaining contains about 60 per cent coal.

130. *Lehigh Valley Coal Company. Springdale Washery.*

Location: 1½ miles northeast of Mahanoy City.
Drainage: Into Mahanoy Creek.

This washery is washing the coal from old Glendon Colliery and old Springdale Colliery. The wash water goes into Mahanoy Creek, taking with it large quantities of silt. It is not settled. The old Springdale bank contains 1,000,000 tons of culm which is approximately 60 per cent coal.

131. *Lehigh Valley Coal Compang. Springdale Washery (ab)*

Location: 1½ miles northeast of Mahanoy City.
Drainage: Into Mahanoy Creek.

This old washery is now abandoned and a culm pile containing 300,000 tons is composed chiefly of very fine-sized coal. This bank is gradually washing into the stream.

132. *Lehigh Valley Coal Company. Park Place Colliery.*

Location: Park Place.
Drainage: Into Mahanoy Creek.

The silt from this colliery is only fairly well settled. It drains across a silt bank which is not properly dammed up. The bank contains 300,000 tons. It is now being worked. The silt is 20 feet deep in the valley and a large quantity is washing away.

133. *Lehigh Valley Coal Co. Old Steels Colliery (Primrose Section)*

Location: 1 mile east of Mahanoy City.
Drainage: Into Mahanoy Creek.

The banks of this old breaker site are now being sent to Springdale Washery. Two large piles aggregating 1,000,000 tons have never been worked. Some silt is mixed with the culm.

134. *Lehigh Valley Coal Co. Buck Mountain Breaker.*

Location: Buck Mountain town.
Drainage: Into Mahanoy Creek.

The silt from this breaker, which is now known as Vulcan Colliery, is settled fairly well by running the water over a bank. The bank contains 50,000 tons.

The coal from old Buck Mountain breaker is now going to Vulcan Colliery. Two culm banks on the old breaker site have never been worked. One bank contains 700,000 tons; the other 300,000. The coal content is between 30 and 40 per cent.

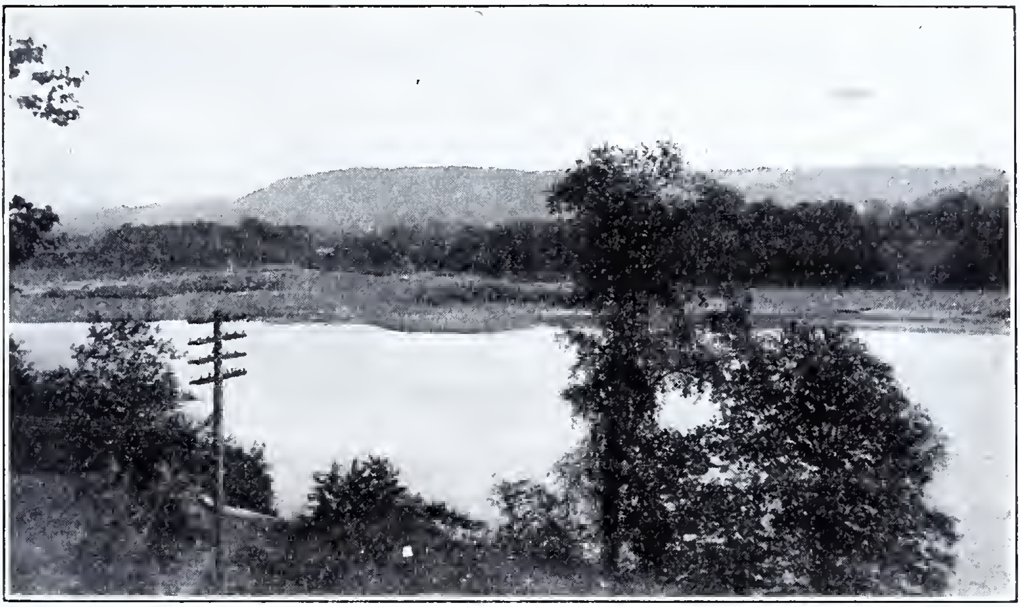
Stream Conditions in the Eastern Middle Field

This coal field has Hazleton as its center and the coal is contained in numerous elongated basins running in a general northeast-southwest direction. Pond Creek, Sandy Run, Black Creek, Hazle Creek, Beaver Creek, and Catawissa Creek are the principal streams in this area. All of them are polluted more or less with mine water and silt.

Pond Creek has its source near Upper Lehigh Colliery of the Hazle Brook Coal Company at the town of Upper Lehigh. Some silt has accumulated along the banks of this stream but only one colliery is discharging silt into it. This silt is gradually washing down the creek. A large swamp approximately 2 miles east of Upper Lehigh acts as a settling basin for it and very little silt reaches farther east than Zehner.

Sandy Run rises near the town of Highlands. It flows eastward past the Sandy Run Colliery of M. S. Kemmerer & Company. This colliery and Highland No. 2 Colliery of the Jeddo-Highland Coal Company are the only ones which discharge silt into the stream. A number of large culm banks are gradually being washed and some of the material is lost. In the vicinity of Sandy Run Colliery a quarter of a million tons of culm have been deposited in the valley of Sandy Run. This culm is gradually being washed away. The swamps south of Sandy Run Colliery contain a large accumulation of silt. The gradient of the stream increases as it flows toward Lehigh River. The water carries the silt away and very little deposition it noticed along its banks near its confluence with the river.

Hazle Creek originates in the town of Hazleton which is built on the water shed between eastward and westward flowing waters. This creek flows eastward through an unpopulated territory to Weatherly where it joins Black Creek (this creek flows eastward and is not the same creek which will be discussed in a later paragraph). Two collieries drain refuse into this creek. Two culm banks are also discharging wash into it. The greatest accumulation of silt is immediately east of Hazleton in the vicinity of Lehigh Valley Colliery. This creek flows through a sparsely populated territory and the deposition of silt along its banks is not detrimental. In the vicinity of Stockton the road has been raised more than 10 feet in order to keep it above the level of the silt. Many thousands of tons of silt are deposited in this creek valley between Stockton and Hazleton. Much of it has very little value. Hazle Creek has a steep gradient through the town of Weatherly and its channel is clean.



A. Mouth of Nescopeck Creek. Large sand and coal bar on far bank.

B. Nescopeck Creek near Catawissa. Its rapid fall keeps the channel clean.

Beaver Creek originates near Jeanesville and Tresckow. This creek drains a very important mining area, an area in which much waste material has been mined. Six collieries are located on its watershed. Some of these collieries are not active but old culm banks at their location furnish the source for much stream silting. These collieries in their earlier days did not attempt to settle the silt and in consequence the broad valley bottom at Beaver Meadow town has been completely covered with silt. This silt has a maximum thickness of 25 feet. The stream fans out over it and is still deposit-

ing fine material from the active collieries. This accumulation is not nearly so great as it has been in the past. Each year this creek washes some of the old material down the stream with a result that its channel is practically filled all the way to its confluence with Hazle Creek. This accumulation is one of the most striking in the anthracite region. Millions of tons of material have been deposited within 2 miles east and west of Beaver Meadow town. The Hazleton-Mauch Chunk highway has been raised several times to keep it above the level of the silt.

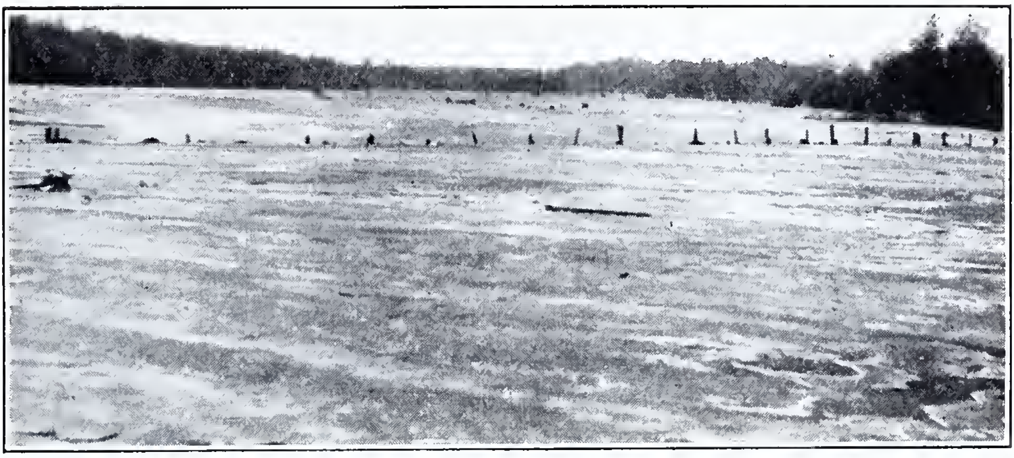
The Candlemas Colliery of the Candlemas Coal Company is the only colliery which drains directly into a tributary of Little Schuylkill River. Old accumulations of culm and silt wash some undesirable material into the creek. This river is comparatively clean as far south as Tamaqua where Panther Creek enters it.

Catawissa Creek has its source in the swampy land in the vicinity of Audenreid. On its headwaters are a large number of old silt banks which are gradually washing into the stream. Several active collieries also discharge silt into it. The headwaters of this creek contain more or less silt, but its gradient is rapid after it leaves the swampy land and very small accumulations of silt can be seen along its bank. Other tributaries entering Catawissa Creek farther westward carry some silt but the pollution is slight. No damage has been done because Catawissa Creek flows through a very sparsely populated territory.

Black Creek, which rises in the swamps in the vicinity of Eckley, carries more silt than any other stream draining the Eastern Middle Field. A dozen active collieries and as many more old culm banks are discharging silt into it. On its headwaters is a large accumulation of silt between Eckley Colliery and the swamp at No. 4 Colliery of the Jeddo-Highland Coal Company. At the Jeddo-Highland Coal Company at Jeddo it has been necessary to move Black Creek and dig a new channel for it. At this point there is a very large accumulation of silt. The surface is not valuable and this accumulation is doing no damage.

The creek flows through a comparatively wide valley from Jeddo to the point where it joins Cranberry Creek. Small accumulations of silt line its banks for its entire distance. The creek has enough water in it to clear its channel at least once yearly and no difficulty has been encountered in keeping the stream within its banks. Large culm banks in the vicinity of Lattimer and Harleigh are washing into the creek.

Cranberry Creek, which is the southern tributary of Catawissa Creek, contains the discharge from three collieries. This creek is black and much silt is accumulated along its valley, particularly in the immediate vicinity of the collieries. The land along this creek is practically uninhabited and no inconvenience has been encountered when it overflows. These collieries are now taking more precaution in settling the solid refuse. From Black Ridge station to the point where the creek leaves the coal-bearing territory the valley is narrow and the gradient of the stream is steep enough to keep its course clear. It gathers more solid material from the wash of old rock and culm banks along its valley.



A. Black Creek near Eckley Colliery.

B. The new channel of Black Creek. It was moved away from the mine workings.

C. View on Black Creek. The water is very black when the collieries are working.

Silt and Culm Conditions at Collieries in the Eastern Middle Field

135. *Buck Mountain Coal Co.*

Location: ¼ mile west of Gowen.
Drainage: Into Black Creek.

This colliery was not visited by the writer, but it was reported to him from authentic sources that a rock pile containing 25,000 tons contains approximately 20 per cent coal. There is no information concerning the disposition of the water.

136. *Coxe Brothers & Co.*

Location: ¾ mile west of Deringer.
Drainage: Into Black Creek.

There is no breaker at this location. The coal is now prepared at Hazleton shaft. A large bank containing approximately 800,000 tons of material contains some coal. Its value is doubtful.

137. *Coxe Brothers & Co.*

Location: 1 mile southwest of Tomhicken.
Drainage: Into Black Creek.

There is no breaker and no silt accumulation at this location. A culm pile containing 35,000 tons of material was made by an old breaker 30 years ago. Its value is not great.

138. *Hazle Mountain Coal Co.*

Location: Black Ridge Station.
Drainage: Into Tomhicken Creek.

No coal is being prepared at this location. Two banks, the remains of waste material from the old breaker, have not been worked over. One bank, composed of a mixture of culm and silt, contains 100,000 tons. Another bank contains 100,000 tons of silt of good quality.

139. *Coxe Brothers & Co. Oneida Colliery (ab).*

Location: Oneida.
Drainage: Into Tomhicken Creek.

The breaker is now abandoned. There is no culm, but a good bank of silt containing 500,000 tons still remains.

140. *Harwood Coal Co.*

Location: Harwood.
Drainage: Into Cranberry Creek.

The water from this breaker goes directly into Cranberry Creek with very little attempt at settling. The silt bank contains 300,000 tons. The culm has been removed.

141. *Cranberry Creek Coal Co. Cranberry Colliery.*

Location: 1 mile west of Hazleton.
Drainage: Into Cranberry Creek.

The breaker water from this colliery is settled fairly well, and the drainage goes into Cranberry Creek. This drainage contains some silt. The silt bank contains 700,000 tons. A culm bank, containing 100,000 tons, is of little value because it has been mixed with ashes.

142. *Lehigh & Wilkes-Barre Coal Co. Honey Brook Colliery.*

Location: ½ mile northwest of Audenreid.
Drainage: Into Catawissa Creek.

The breaker water goes directly into Catawissa Creek without first being settled. Some of it has been run out upon a culm bank. This culm bank contains 400,000 tons of a silt and culm mixture. It is being worked for boiler fuel.

143. *Lehigh & Wilkes-Barre Coal Co. Audenreid Colliery.*

Location: ¼ mile northwest of Audenreid.
Drainage: Into Catawissa Creek.

The silt-bearing breaker water goes directly into Catawissa Creek and some of it is diverted into an old stripping. One bank, containing 300,000 tons, is a mixture of culm and silt. Another bank, which is old, contains 100,000 tons. An attempt was made to work it but there was too much ash in the mixture.

144. *Candlemas Collieries Co. Candlemas Colliery.*

Location: At New Silver Brook.
Drainage: Into Pine Creek.

The breaker water goes directly into a tributary of Little Schuylkill River. The silt-bearing water goes into an old mine cave. The colliery is new and very little silt is being made. A culm bank containing 100,000 tons is poor. An unsuccessful attempt has been made to work it. This colliery now operated by Haddock Mining Co.

145. *Lehigh & Wilkes-Barre Coal Co. Tresckow Colliery.*

Location: Tresckow.
Drainage: Into Beaver Creek.

This breaker is abandoned. An old culm bank of doubtful value contains 15,000 tons.

146. *Lehigh Valley Coal Company. Spring Brook Colliery.*

Location: Audenreid.
Drainage: Into Catawissa Creek.

This washery has been washing a bank from an old breaker. The bank contains 100,000 tons, and some parts of it are good.

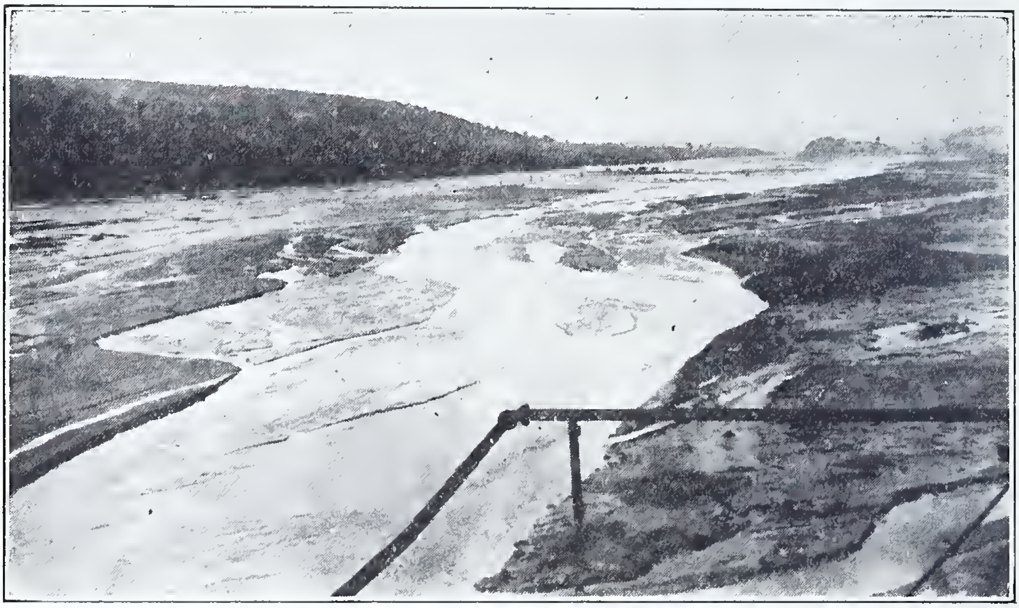
147. *Dodson Coal Co. Beaver Brook Colliery.*

Location: Audenreid.
Drainage: Into Catawissa Creek.

The breaker water from this bank drains into Catawissa Creek after it has been fairly well settled. The bank contains 200,000 tons. Many small piles of culm scattered over the breaker ground contain an aggregate of 200,000 tons.

PLATE XVIII

A. Silt in the valley at Stockton. The road has been raised ten feet.



B. Stream deposit at Beaver Meadows looking up-stream. The silt has a maximum thickness of 20 feet.

148. *Lehigh Valley Coal Co. Spring Mountain Colliery.*

Location: Jeanesville.
Drainage: Into Beaver Creek.

The water carrying the silt from this breaker goes into Beaver Creek and settles in the valley. An old bank containing 300,000 tons of culm and silt mixture is on the property. A small bank, containing 75,000 tons of culm and silt, is the remnant of the material from an old breaker.

149. *Coleraine Coal Co. Washery.*

Location: Coleraine, ¼ mile west of Beaver Meadows.
Drainage: Into Beaver Creek.

This washery is working a pile of rock and culm from old Coleraine breaker of the old Van Wickle Estate. The pile contains 200,000 tons of very poor culm. Old Coleraine colliery is worked out. The silt went into Beaver Creek.

150. *Evans Colliery Co.*

Location: Beaver Meadows.
Drainage: Into Beaver Creek.

The breaker water, after going over a field, drains into Beaver Creek carrying much silt. 10,000 tons of silt is scattered over the fields, and one pile contains 15,000 tons.

151. *Coxe Brothers & Company. Beaver Meadow Colliery.*

Location: Beaver Meadows.
Drainage: Into Beaver Creek.

The breaker water is run up on the top of a rock pile and then seeps through. The water is not well settled and some silt goes into Beaver Creek. The pile contains 35,000 tons of silt. There is no culm, but the rock bank contains some good coal.

152. *Lehigh Valley Coal Co. Hazleton No. 1 Colliery.*

Location: Southwest corner of Hazleton Boro.
Drainage: Into Cranberry Creek.

The breaker water goes into a settling tank and the silt is pumped out onto a bank. Some silt gets away, but as a rule the settlement is very good. This colliery is reclaiming silt that has been washed into the valley. It averages 10 feet thick and covers a large area. There is approximately 300,000 tons in the valley. In addition to this accumulation there is a silt bank containing 200,000 tons. There is no culm, and the rock bank contains little good coal.

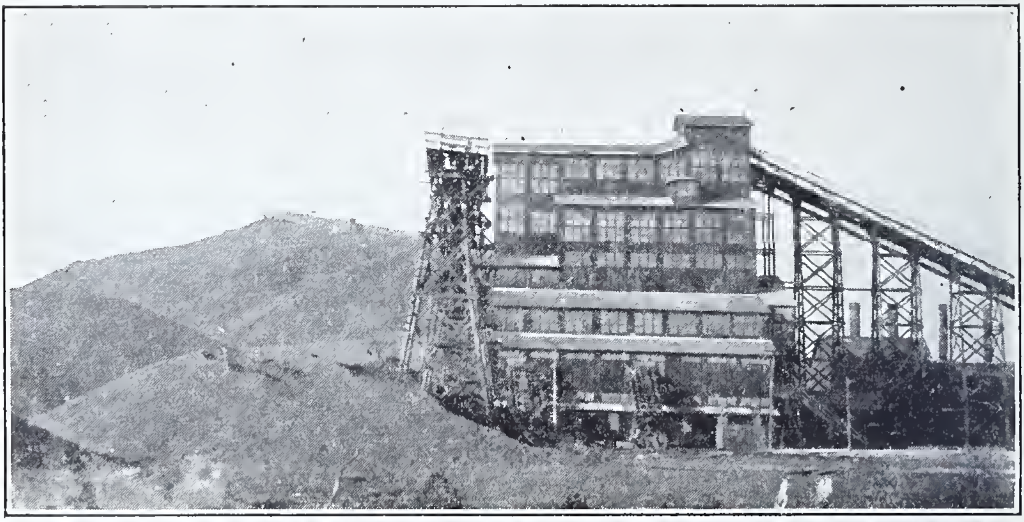
153. *Lehigh Valley Coal Co. Hazleton Shaft Colliery.*

Location: ¼ mile northeast of Hazleton.
Drainage: Into Hazle Creek.

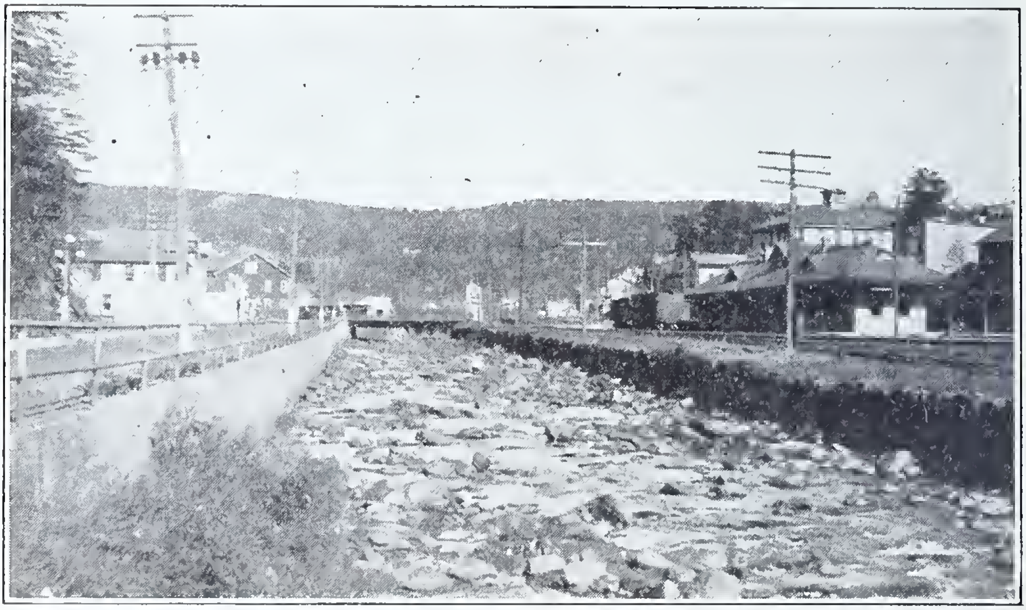
The breaker water from this colliery goes onto the bank and is fairly well settled. This bank contains 250,000 tons. An old culm bank from No. 3 colliery, which is now abandoned, contains 125,000 tons. It is now being loaded for the first time and is an excellent bank.

154. A 100,000 ton accumulation of silt occurs in the valley just east of Hazleton Shaft. This accumulation is from Old Sugar Loaf and South Sugar Loaf collieries which were working between 1850 and 1898.

PLATE XIX



A. Pardee Bros. & Co. Lattimer Breaker. New mechanical equipment for recovering and cleaning the silt is being installed at this breaker.



B. Hazle Brook in Weatherly. The narrow channel and a fairly rapid fall keep the creek bed clean of silt.

155. *Hazle Brook Colliery.*

Location: 4 miles east of Hazleton.
Drainage: Into Hazle Creek.

This colliery is worked out and abandoned. This company is now stripping in Porter swamp. There is no culm or silt accumulation, except in some old strip pits. It is impossible to estimate the quantity.

156. *Pardee Brothers & Co. Lattimer Colliery.*

Location: Lattimer.
Drainage: Into Black Creek.

The breaker water runs back into old Carter basin. It is almost impossible to estimate the quantity of this accumulation because its actual depth is not known. There is probably 500,000 tons in the pile. The culm has been worked over.

157. *Pardee Brothers & Co. Lattimer Colliery No. 3.*

Location: ½ mile west of Lattimer.
Drainage: Into Black Creek.

This breaker is abandoned. There is no culm, but a silt bank contains 100,000 tons.

158. *Harleigh Coal Co. Washery.*

Location: ¼ mile west of Harleigh.
Drainage: Into Black Creek.

This washery is working a culm pile from old Harleigh-Brookwood colliery. They are using a Chance separator. The bank contains 100,000 tons of slate and coal mixed.

159. *Jeddo-Highland Coal Co. Harleigh Colliery.*

Location: Harleigh.
Drainage: Into Black Creek.

This breaker has a settling tank and a settling basin. A very small quantity of silt goes into Black Creek. The silt is mixed with rock and used to fill up an old stripping. The depth of the stripping is not known, but it may hold 800,000 tons of the mixture.

160. *Jeddo-Highland Coal Co. No. 4 Colliery.*

Location: Jeddo.
Drainage: Into Black Creek.

The breaker water is fairly well settled at the breaker, but much silt goes into Black Creek. There are 600,000 tons of silt in the bank and in the valley of Black Creek adjacent to it. The culm banks have been worked over. Only the fine sizes remain and these are mixed with silt.

161. *Jeddo-Highland Coal Co. No. 5 Colliery.*

Location: 1 mile west of Eckley.
Drainage: Into Black Creek.

The breaker water is settled in an excellent basin. The drainage goes into Black Creek but there is very little silt. This bank contains 400,000 tons. There is no culm.

PLATE XX

A. Sandy Run near Weatherly.

B. Scotch Run near its mouth. Both mountain streams are polluted and carry silt.

162. *Coxe Brothers & Co. Eckley Colliery.*

Location: Eckley.
Drainage: Into Black Creek.

The silt is settled in the valley in the headwaters of Black Creek. Some is washing away. This deposit varies from a few inches to 20 feet thick. It contains 500,000 tons. No culm belongs to this property, but near by an old bank from Eckley No. 5 colliery of the Wentz interests remains intact. It contains 200,000 tons of good material.

163. *Coxe Brothers & Co. Drifton Colliery.*

Location: Drifton.
Drainage: Into Black Creek.

Formerly the water from this breaker went directly into Black Creek. It is now settled. However, some of it goes into the stream. Two banks contain a total of 300,000 tons. The culm bank has been worked over.

164. *Jeddo-Highland Coal Co. No. 2 Colliery.*

Location: ½ mile south of Highland.
Drainage: Into Black Creek.

The silt from this breaker is fairly well settled, but some of it goes into the creek. An accumulation of 200,000 tons in the creek bottom on the headwaters of Black Creek is being worked for boiler fuel. It is excellent silt. The coal is now being prepared at Highland No. 5.

165. *M. S. Kemmerer. Sandy Run Colliery.*

Location: Sandy Run.
Drainage: Into Sandy Run.

The silt from this breaker goes into Sandy Run valley. Much of it is washed away. There are 250,000 tons in place. There is no culm.

166. *Hazle Brook Coal Co. Upper Lehigh Colliery.*

Location: Upper Lehigh.
Drainage: Into Pond Creek.

The breaker water is well settled at this colliery. There is an accumulation of 150,000 tons at the breaker and in the valley of Pond Creek. A culm bank containing 150,000 tons is being loaded and being used by the New Jersey Zinc Company.

167. *East Point Coal Company.*

Location: Zehner.
Drainage: Into Pond Creek.

This breaker is abandoned. The old silt pile was shipped during the war. A small culm pile containing 5,000 tons is of little value.

Stream Conditions in the Northern Field

The Northern Anthracite Field extends from a point 2 miles north of Forest City to Shickshinny. It is drained by Lackawanna and Susquehanna rivers and their tributaries. Anthracite is mined practically continuously from one end of the field to the other. The northernmost anthracite mine is that of the Clifford Coal Company 2 miles north of Forest City on the northern outcrop of the coal beds. This colliery is now abandoned and very little silt is now accumulated in the stream between this point and Forest City. The Forest City Colliery of the Pennsylvania Coal Company is at Forest City, and it is here that the first silt pollution of the stream takes place. This colliery has been working for a great many years and has been discharging more or less silt into the stream. Very little silt is going into the river from this colliery at the present time. From Forest City southwestward Lackawanna River is never entirely free from silt.

The next source of stream pollution is the Clinton Colliery of the Hudson Coal Company. The stream is comparatively clean between Forest City and the mouth of Elk Creek. Elk Creek carries some silt from Richmondale Colliery of the Richmondale Coal Company. Southwest of the mouth of Elk Creek a considerable quantity of silt has collected in the lowlands of Lackawanna River. Through Carbondale, however, the river is clean. It is kept so by borough officials who during the summer have the fire department wash out the river bed. This keeps the river bed at its normal level and it is not abnormally raised by silt.

Several small streams flow into the Lackawanna in the vicinity of Carbondale, and each of them brings in some silt. No inconvenience is caused by the silt of the Lackawanna in the vicinity of Carbondale and southward to Mayfield. The banks are comparatively high, the river is rapid, and there is very little overflow.

Rush Brook enters the Lackawanna at Jermyn. It carries a small quantity of silt. There is no difficulty with silt accumulations in the town of Jermyn. Between Jermyn and Carbondale two collieries, Powderly and Jermyn, discharge some silt into the river. From Archbald to Peckville there are a large number of collieries, practically all of which discharge some silt into the Lackawanna. Grassy Island Creek also carries some silt into the river.

The river at Olyphant contains some silt which has been left behind when high water recedes. The same condition is true at Peckville. High water has carried a large quantity of silt into the river and has caused a number of properties to be flooded. All the small streams between Olyphant and Scranton carry some silt into the river. The water is black and deposits of silt are present throughout its entire channel. Its fall is rather rapid, and the main channel is comparatively clean.

At Scranton the South Penn Collieries Company is settling silt out of the Lackawanna and using it for filling. A large settling tank is built around a bore hole, and a low dam across the river diverts part of the stream into the settling tank. This water flows into the tank for 8 hours. It is then diverted from the tank, the bore hole is opened, and the silt which has collected is washed into

the mine. Approximately 300 tons of silt are recovered from the river in 8 hours. The river at this point carries at least 900 tons of silt in 24 hours.

Lackawanna River through the city of Scranton is nothing more than an open sewer. Private encroachments have narrowed its channel and accumulations of silt have covered a great many sewer outlets. The channel of the Lackawanna should be deepened through the city.

A great number of breakers discharge silt into the river between Scranton and Taylor. The water is heavily laden with solids and much deposition has taken place. The side streams between these two points are short, but collieries are located on all of them, and they are black with suspended material. At Taylor the whole stream bed is filled with silt but no damage is being done. From Taylor to Old Forge the river is rather rapid and cleans its bed. From Old Forge to Pittston the valley of Lackawanna River is comparatively wide and no damage has been done by the accumulation of silt. The water of the Lackawanna is very black where it enters the Susquehanna. Shallows have been built up of silt north of the city of Pittston. The Susquehanna carries much more water than the Lackawanna and has been able to keep the channel clear. Southwest of Pittston at Port Griffith a large delta is made in the river by a stream which carries the silt from Ewen Colliery of the Pennsylvania Coal Company. Between Pittston and Wilkes-Barre the valley of the Susquehanna is wide. The banks of the river are black with sticky mud which is not more than 12 inches thick. When freshlets come this mud is washed down the river so that there is little accumulation of silt between these two points. A great number of collieries are located on Susquehanna River or its tributaries between Pittston and Shickshinny. Large quantities of silt are deposited in the river each year but spring freshets keep its channel clear. Some silt deposits are notable. A very large delta is formed at the mouth of Newport Creek at Nanticoke. Mill Creek, which drains Parsons, Miners Mills, and Plains carries a large quantity of silt. Mill Creek often floods and the water spreads over Hollenbeck Park. This creek does not cause any trouble between this point and the river because its banks are high.

Abraham Creek flows into the Susquehanna at Wyoming. Because it carries a large quantity of silt and has caused the borough of Wyoming some difficulty, it has been dredged out at various times. Toby Creek enters the Susquehanna at Kingston and carries into it large quantities of silt. The creek has a rapid fall and very little deposition has taken place along its banks. A small creek entering the Susquehanna between Larksville and Plymouth carries a large quantity of silt and has built up a delta into the Susquehanna.

Buttonwood Creek flows into the Susquehanna just south of Plymouth and drains a large territory south of Wilkes-Barre. It carries a large quantity of silt, it has a large flood plain, travels through territory of very little value, and causes no damage. One of its branches, Solomans Creek, often overflows and causes damage in south Wilkes-Barre. This tributary is dredged when the silt accumulates to a dangerous point.

Warrior Creek drains into the Susquehanna 1 mile southwest of Butzbach. This stream carries breaker water from a number of collieries and its flood plain is covered with layers of silt. It has flooded some fields and caused much damage. The silt in these fields is from a few inches to a foot and a half thick. Nanticoke Creek flows into Newport Creek at Nanticoke. This creek drains all of the territory between Moyer Run and Nanticoke. It carries much silt but has done very little damage. Below Warrior Run the creek crosses the middle road to Wilkes-Barre and at this point has deposited some silt. The stream is building up new banks and the silt is held in place by the vegetation growing in the shallow water. At Loomis Colliery the fields are covered with silt to a considerable depth. This is an extremely large accumulation of free silt. Where Nanticoke Creek passes under the river road between Wilkes-Barre and Nanticoke the stream conditions are bad. A flume has been built through the silt deposits to carry the water away.

Newport Creek flows into the Susquehanna at Nanticoke. It carries a very large quantity of silt. The branch which flows through the town of Wanamie carries more silt than that coming from Glen Lyon. The banks of Newport Creek are covered with silt accumulations and the bed has been built up several feet. When the water is high it spreads over a large territory and deposits much silt, especially between Nanticoke and its mouth.

From Nanticoke to Shickshinny there are no streams carrying silt into the river. Some silt is being discharged into the river at Moconaqua and a delta is built up. This delta is washed away at times of high water.

The North Branch of the Susquehanna is black until it reaches Sunbury. Here it is diluted with the waters of the West Branch. Coal dredging operations are located at various points between Plymouth and the Maryland line. The damage from silt from the anthracite region is negligible.

In general the deposition of silt in the rivers of the Northern Anthracite Fields has caused very little damage. Local conditions can be remedied readily by borough or county officials. The coal companies in this field have been making some attempt to keep much of the solid material out of the streams. The discharge of mine and breaker water into the river has a beneficial effect in cleansing the stream of sewage accumulation. Much improvement has been made in settling the silt in the Northern Field in the past few years.

Silt and Culm Conditions at Collieries in the Northern Field

168. *Stackhouse Coal Company. Salem Colliery.*

Location: Mocanaqua.
Drainage: Into Susquehanna River.

The silt from this colliery is accumulated in the valley in a good settling basin which contains 200,000 tons. There is no culm bank. The rock bank is no good.

169. *West End Coal Co. Mocanaqua Colliery.*

Location: Mocanaqua.
Drainage: Into Susquehanna River.

This colliery partially settles its silt. A fairly good bank contains between 50,000 and 75,000 tons. Some of the breaker water goes into the river.

170. *Susquehanna Collieries Co. Glen Lyon No. 6 Colliery.*

Location: Glen Lyon.
Drainage: Into Newport Creek.

The breaker water is not settled, and much silt goes into Newport Creek. Some silt has been used inside the mine. The culm bank was being worked during the summer of 1925. The bank contained 1,300,000 cubic yards, April, 1925, or approximately 900,000 tons of material, of which 19 per cent is refuse.

171. *Lehigh & Wilkes-Barre Coal Co. Wanamie Colliery.*

Location: Wanamie.
Drainage: Into Newport Creek.

The breaker water goes into the mines for slushing. Some goes into the river. The breaker has settling tanks.
A culm bank contains 250,000 tons, and has not been worked.

172. *East Alden Mining Company. East Alden Colliery.*

Location: 1 mile southeast of Alden.
Drainage: Into Newport Creek.

A well-kept silt bank settles the water from this breaker. It contains 15,000 tons. There is no culm, and the rock bank has very little good coal in it.

173. *Alden Coal Company. Alden Colliery.*

Location: Alden Station.
Drainage: Into Newport Creek.

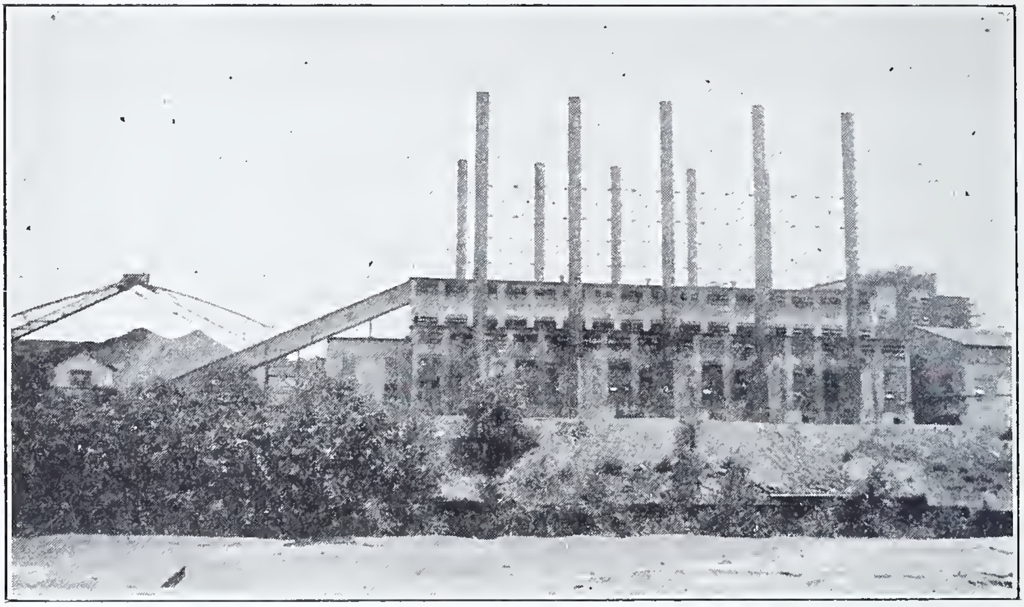
A silt bank was built up at this location from an old washery. It covers 4 acres, and contains 150,000 tons. At the new breaker the water goes directly into the stream. Some flushing has been done but this has been discontinued. The old part of the rock pile contains some good coal. The culm originated from an old dry breaker. There is less than 60,000 tons of this material.

174. *Susquehanna Collieries Company. Nanticoke No. 7 Colliery.*

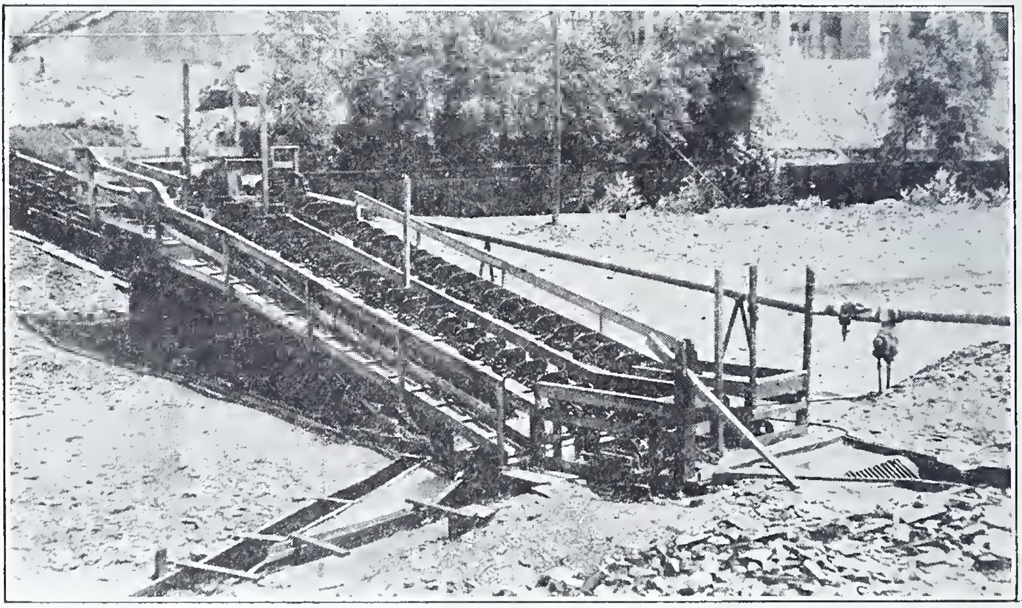
Location: Nanticoke.
Drainage: Into Newport Creek.

The culm pile contains 30,000 tons of recoverable coal. It is being worked and washed by a Chance separator. The breaker water is run out onto a 35,000 ton silt bank. The fine sizes from the culm banks are treated in a jig washery. Current silt from breaker and washery and from Glen Lyon is used in the power plant.

PLATE XXI



A. Slush-burning boiler plant, Susquehanna No. 7 Colliery, Nanticoke. This company is the leader in utilizing waste material.



B. Settling tank and scraper line for desliming silt for power plant fuel at Susquehanna No. 7 Colliery, Nanticoke.

175. *Grand Tunnel Coal Company. West Nanticoke Colliery.*

Location: West Nanticoke.

Drainage: Into Susquehanna River.

All the coal from this colliery is shipped to another breaker for preparation. The culm bank has been worked over. Approximately 60,000 tons is all that remains of an old silt bank.

176. *Geo. F. Lee Coal Company. Chauncey Colliery.*

Location: Plymouth.
Drainage: Into Susquehanna River.

The water from this breaker is well settled in a good silt bank which contains 40,000 tons. The culm bank contains 50,000 tons, is good, and is being put through the breaker.

177. *Glen Alden Coal Company. Avondale Colliery.*

Location: Avondale.
Drainage: Into Susquehanna River.

The silt bank at this colliery is well built up and the water well settled. The bank contains 200,000 tons. An old culm pile is now being worked. It was a quite large bank. An estimate was not obtained of the quantity which it contained.

178. *Glen Alden Coal Company. Auchincloss Colliery.*

Location: East end of Nanticoke.
Drainage: Into Nanticoke Creek.

The coal goes to Loomis for preparation. A large old culm bank on the property has never been worked, and appears to be good. There is also a fair-sized silt bank on the property. It probably contains 200,000 tons. An old culm bank contains approximately 300,000 tons.

179. *Glen Alden Coal Company. Bliss Colliery.*

Location: 1½ miles south of Nanticoke.
Drainage: Into Nanticoke Creek.

There is a large accumulation of silt at this colliery which is built up very well. The bank probably contains 250,000 tons. An old original culm pile has never been worked. It contains approximately 500,000 tons and looks very good.

180. *Glen Alden Coal Company. Truesdale Colliery.*

Location: Warrior Run.
Drainage: Into Warrior Run.

The water from this breaker is fairly well settled. The silt bank contains 200,000 tons. A large, old culm bank has never been worked. It probably contains 500,000 tons. Much of it is good coal.

PLATE XXII

A. Reclaiming silt and culm hydraulically at No. 7 Colliery, Susquehanna Collieries Co., Nanticoke.

B. Silt in Newport Creek at Nanticoke. Many collieries drain water into this creek.

181. *Lehigh Valley Coal Company. Warrior Run Colliery.*

Location: Warrior Run.
Drainage: Into Susquehanna River.

The coal from this colliery is being prepared at Prospect breaker. There is no silt bank. The culm bank, which is small and nearly exhausted, is loaded into railroad cars and sold when the market permits.

182. *Glen Alden Coal Company. Loomis Colliery.*

Location: 1¾ miles northeast of Nanticoke.
Drainage: Into Warrior Run.

The silt bank at this colliery is well built up, but could not be measured because entrance to the property was refused. This bank probably contains 200,000 tons. A culm pile contains 300,000 tons of fairly good material.

183. *Pittston Coal Mining Company. Hadley Colliery.*

Location: Sugar Notch.
Drainage: Into Warrior Run.

The water from this breaker is well settled. The silt bank contains 250,000 tons. The culm bank has been worked over but still contains some good coal.

184. *Lehigh & Wilkes-Barre Coal Company. Sugar Notch No. 9.*

Location: Sugar Notch.
Drainage: Into Warrior Run.

All the slush from this breaker is used inside the mine. An old culm bank has been worked over and the remaining material is of little value.

185. *Lehigh & Wilkes-Barre Coal Co. Buttonwood No. 22 Colliery.*

Location: Butzbach.
Drainage: Into Buttonwood Creek.

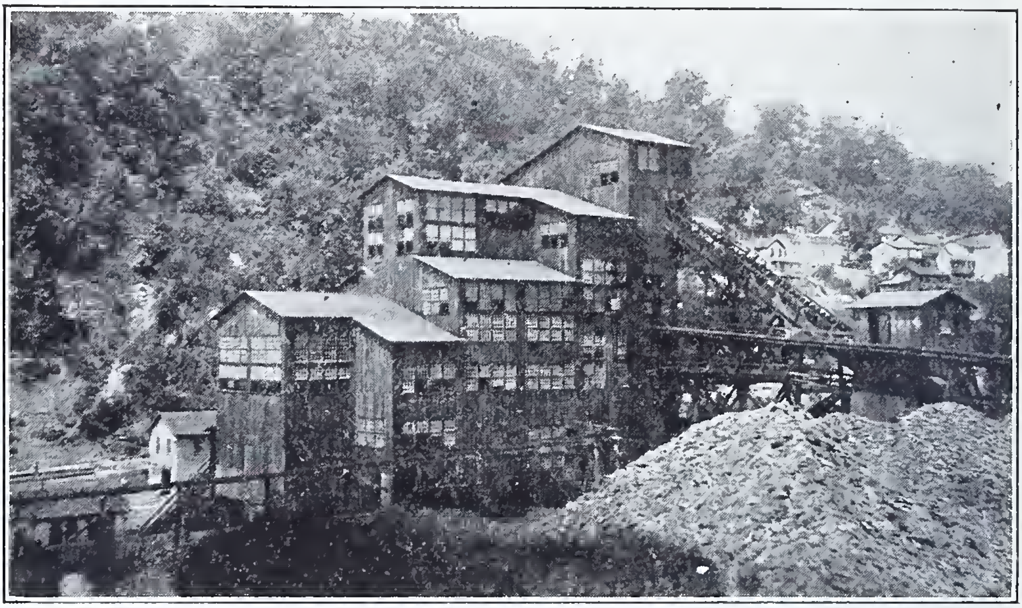
The water from this breaker spreads out over a large silt bank which is well dammed up. It contains from 150,000 to 200,000 tons. The culm bank has been worked over. The rock pile contains no good coal.

186. *Lehigh & Wilkes-Barre Coal Co. Maxwell Colliery.*

Location: Ashley.
Drainage: Into Buttonwood Creek.

All the breaker water is used inside for flushing. There is no silt bank. Very little coal goes into the stream from this breaker. The culm pile has been worked over and contains no good coal.

PLATE XXIII



A. Chauncey breaker, George F. Lee Coal Co. One of the first breakers to install the Chance cone.

B. Silt bank at Chauncey Colliery showing pipe line delivering silt and water from breaker.

187. *Lehigh Valley Coal Company. Franklin Colliery.*

Location: Ashley.
Drainage: Into Buttonwood Creek.

All the water from this breaker goes back inside the mine. There is no silt accumulation on the surface. An old culm bank has been worked over and has no value. The rock pile contains no good coal.

188. *Lehigh & Wilkes-Barre Coal Co. Stanton No. 7 Colliery.*

Location: Wilkes-Barre.
Drainage: Into Buttonwood Creek.

Most of the breaker water and silt from this colliery goes back into the mine. Some goes into the creek. An old culm and silt bank contains 150,000 tons of material. The rock bank contains very little good coal.

189. *Lehigh & Wilkes-Barre Coal Co. South Wilkes-Barre No. 5 Colliery.*

Location: Wilkes-Barre.
Drainage: Into Buttonwood Creek.

There is no silt accumulation at this colliery. All the breaker water is flushed back into the mines. There is no rock or culm bank. All waste material is kept inside the mines.

190. *Plymouth Red Ash Coal Co.*

Location: Plymouth.
Drainage: Into Susquehanna River.

This is a dry breaker and there is no silt discharge. The rock is stacked and contains very little good coal. There is no culm bank.

191. *Lehigh & Wilkes-Barre Coal Co. Nottingham Colliery.*

Location: Plymouth Boro.
Drainage: Into Susquehanna River.

All silt from this breaker goes back into the mines except when the pipes are clogged and then it goes directly into the river. There is no provision for settling on the surface. A culm bank, which contains 5,000 tons, is a remnant of a large old bank.

192. *Plymouth Coal Co.*

Location: Plymouth.
Drainage: Into Susquehanna River.

This breaker is now abandoned. An old silt bank contains 5,000 tons. A culm bank, containing 10,000 tons, has been worked, but the steam sizes remain.

193. *Lehigh & Wilkes-Barre Coal Co. Lance No. 11 Colliery.*

Location: Larksville Boro.
Drainage: Into Susquehanna River.

There is no silt bank at this colliery. A large part of the water is used for silting inside. The culm bank contains 1,000,000 tons. It has been worked only a little. It is a fair bank. Silt is run over it when the silting pipes are clogged. There is no settling basin.

194. *Lehigh & Wilkes-Barre Coal Co. Hollenback Colliery.*

Location: Wilkes-Barre.
Drainage: Into Susquehanna River.

All surface refuse is now ground up and put back into the mines. The breaker water goes into the mine. There is no silt bank. A culm pile contains 100,000 tons of fair material. The rock pile contains some good coal.

195. *Sullivan & Flynn Coal Co.*

Location: Wilkes-Barre.
Drainage: Into Susquehanna River.

The breaker water goes back into the mines. There is no silt. A culm bank contains 50,000 tons. The rock pile contains no good coal.

196. *Hudson Coal Company. Baltimore No. 5 Colliery.*

Location: ½ mile east of Wilkes-Barre.
Drainage: Into Laurel Run.

Some breaker water is used inside the mine but most of it goes onto a good bank containing 150,000 tons. A good culm bank containing 200,000 tons of material has not been worked.

197. *Lehigh Valley Coal Co. Dorrance Colliery.*

Location: Wilkes-Barre.
Drainage: Into Susquehanna River.

The silt from this breaker goes back into the mine. There is no surface accumulation. All of the old culm bank has been shipped.

198. *Lehigh Valley Coal Co. Mineral Springs Colliery.*

Location: Parsons Boro.
Drainage: Into Laurel Run.

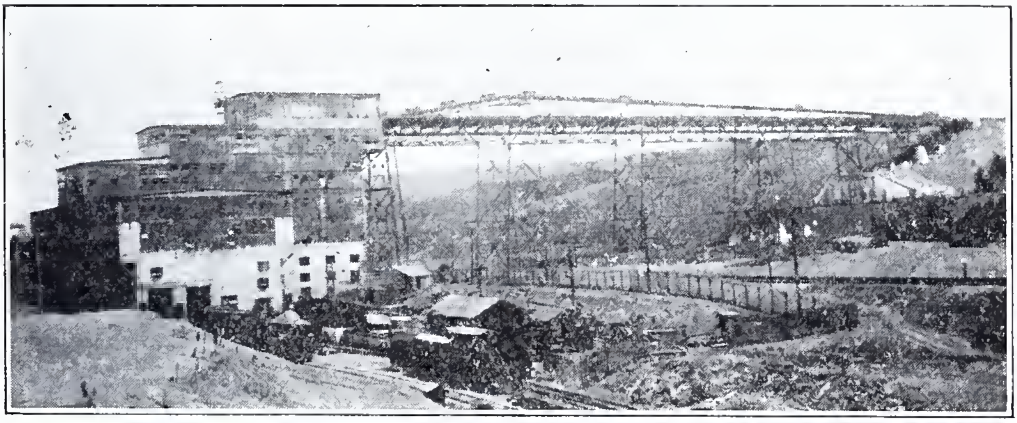
The silt goes back into the mine. Not much is wasted. All the solid waste is run through a pulverizer and flushed back in the mines. A culm bank, containing 200,000 tons, is good. It has never been worked except for boiler fuel during strikes.

199. *Hudson Coal Co. Pine Ridge Colliery.*

Location: Miners Mills Boro.
Drainage: Into Laurel Run.

The water from this breaker goes back into the mine where the silt is settled out. The culm bank has been worked out. A bank on Laurel Run which belongs to this property contains 250,000 tons. It is a very fine bank.

A. Hollenback Park, Wilkes-Barre, Silting by Mill Creek.



B. Butler breaker and washery, Pennsylvania Coal Co. (under construction). A modern colliery, designed to recover all sizes of coal.

200. *Lehigh Valley Coal Co. Prospect Colliery.*

Location: Wilkes-Barre.
Drainage: Into Susquehanna River.

The silt is now being put into the mine. A culm and silt bank, containing 500,000 tons, is in good condition. This bank is old.

201. *Lehigh Valley Coal Co. Henry Clay Colliery.*

Location: Wilkes-Barre.
Drainage: Into Susquehanna River.

This colliery is a part of Prospect colliery, and is described under that name.

202. *Conlon Coal Co.*

Location: Hudson Boro.
Drainage: Into Mill Creek.

The water from this breaker is being used to flush into the mines. Very little goes into the creek. There is no culm pile, and the rock bank contains no good coal.

203. *Central Coal Co. Wyoming Colliery.*

Location: Plains Township.
Drainage: Into Mill Creek.

The breaker water is not settled at this colliery. It goes directly into the creek. There are no culm or silt accumulations.

204. *Colonial Colliery Co. Madeira Colliery.*

Location: Hudson.
Drainage: Into Mill Creek.

The silt from this breaker is used for flushing inside. Very little goes into the stream. The culm pile has been loaded out. The rock bank is large but contains very little good coal.

205. *Hudson Coal Co. Laflin Colliery.*

Location: Laflin.
Drainage: Into Mill Creek.

The silt is settled at this colliery but some of it goes into the creek. An estimate of tonnage was not obtainable. Formerly all slush and waste water was flushed into the mines.

206. *Traders Coal Co. Ridgewood Colliery.*

Location: 1½ miles southeast of Inkerman.
Drainage: Into Mill Creek.

The breaker water is settled on a silt bank which contains 30,000 tons. The silt bank is in good condition. A mixed rock and culm bank is partly burned. It contains 200,000 tons. Some of it has been loaded but it is poor material.

207. *Hudson Coal Co. Loree No. 5 Colliery.*

Location: Larksville Boro.
Drainage: Into Susquehanna River.

The breaker water goes into the river taking the fine-sized coal with it. A culm bank, containing 50,000 tons, has been partially worked. The rock pile contains no good coal.

208. *Kingston Coal Co. Gaylord Colliery.*

Location: ½ mile north of Plymouth.
Drainage: Into Susquehanna River.

Settling tanks at this colliery remove the silt from the waste water. The silt is used inside the mine. No rock is brought to the surface. A culm pile contains 10,000 tons.

209. *Kingston Coal Co. Kingston No. 2 Colliery.*

Location: Edwardsville Boro.
Drainage: Into Susquehanna River.

All waste products of this breaker were flushed inside the mines.

210. *Glen Alden Coal Co. Woodward Colliery.*

Location: Edwardsville Boro.
Drainage: Into Susquehanna River.

Part of the wash water goes back into the mines; some goes into the river. The rock is crushed and used inside. There is no silt bank. A culm pile, containing 50,000 tons, has been worked intermittently.

211. *Kingston Coal Co. Kingston No. 4 Colliery.*

Location: Edwardsville Boro.
Drainage: Into Susquehanna River.

There is no silt bank at this colliery. All the silt from the breaker and the washery connected with it is sent back into the mines. The rock is crushed and goes back into the mines also. The culm bank has been worked over, but approximately 100,000 tons of fine-sized materials are left.

212. *Glen Alden Coal Co. Pettebone Shaft.*

Location: Kingston.
Drainage: Into Toby Creek.

The water from this breaker is settled fairly well before it goes into the creek. Some of it is used for flushing. There are 60,000 tons of culm in a good settling basin. An old culm bank has almost all been loaded out.

213. *East Boston Coal Co.*

Location: Pringle Boro.
Drainage: Into Toby Creek.

A concrete reservoir for settling the breaker water was installed in 1925. The silt is to be used inside the mine. It formerly went into a field and then into the creek. There are two culm banks; one contains 200,000 tons, and has never been worked, except for boiler fuel. The other bank is put through the breaker. It contains 500,000 tons, and is also a good bank.

214. *Haddock Mining Co. Black Diamond Colliery.*

Location: Luzerne Boro.
Drainage: Into Toby Creek.

All of the breaker water is used for flushing inside. The rock bank contains very little good coal. The culm bank has been loaded out.

215. *Raub Coal Co.*

Location: Luzerne Boro.
Drainage: Into Toby Creek.

The silt from this colliery is put back inside. None goes into the stream. The culm bank has been used, and the rock pile contains only a small percentage of good coal.

216. *Temple Coal Co. Harry E. Colliery.*

Location: Swoyersville Boro.
Drainage: Into Toby Creek.

The breaker water is well settled at this colliery, and the bank contains 250,000 tons. The waste water going to the river carries some fine solids. The culm pile has been worked over. A large rock bank contains very little good coal.

217. *Temple Coal Co. Forty Fort Colliery.*

Location: Swoyersville Boro.
Drainage: Into Abraham Creek.

The silt from this colliery spreads out into a swamp and some of it eventually reaches the river. This swamp contains approximately 200,000 tons of silt. The culm pile has been worked over and only some fine-sized material remains, and that is of poor quality. The coal is now being prepared at Harry "E" Colliery.

218. *Lehigh Valley Coal Co. Maltby Colliery.*

Location: Swoyersville Boro.
Drainage: Into Abraham Creek.

Some slushing is being done at this colliery, but the greater part of the breaker water is well settled in a basin which contains 50,000 tons; 150,000 tons of silt are scattered over the breaker location. The culm banks have been worked over with the exception of a small area below Maltby breaker. Approximately 50,000 tons remain.

219. *Lehigh Valley Coal Co. Westmoreland Colliery.*

Location: West Wyoming.
Drainage: Into Abraham Creek.

All slush goes into the river. There is no settling area. None of the silt is used inside. The culm bank is very small. The rock bank is on fire.

220. *Healey Coal Co. Troy Colliery.*

Location: West Wyoming.
Drainage: Into Abraham Creek.

The silt is spread out into an adjoining field and no estimate was made of the quantity. The water runs right through the silt into the creek. The culm bank has been practically worked over. 100,000 tons of poor material remain.

221. *Temple Coal Co. Mt. Lookout Colliery.*

Location: Exeter Boro.
Drainage: Into Susquehanna River.

The breaker water is spread out over a swamp and 300,000 tons of silt is deposited there. Some of it finds its way to the river. This silt would be very hard to recover. There is no culm. The rock pile is on fire and there is very little good coal in it.

222. *Harris-Denly Coal Co. Kintz Colliery.*

Location: West Pittston.
Drainage: Into Abraham Creek.

This breaker has a good settling basin which contains 50,000 tons of silt. Not much of it is used inside. This breaker started in 1919 and has no culm.

223. *Lehigh Valley Coal Co. Exeter Colliery.*

Location: Exeter Boro.
Drainage: Into Susquehanna River.

The silt is fairly well settled on a large pile containing 200,000 tons. Some goes into the stream. The rock pile is no good and the culm has all been removed.

224. *Pennsylvania Coal Co. No. 14 Colliery.*

Location: 1¼ miles northeast of Plainsville.
Drainage: Into Susquehanna River.

The breaker water goes directly into the stream without settling. The culm banks have been worked over, but Frank Benjamin is loading some of them. Some silt, probably 150,000 tons, is scattered over the breaker property.

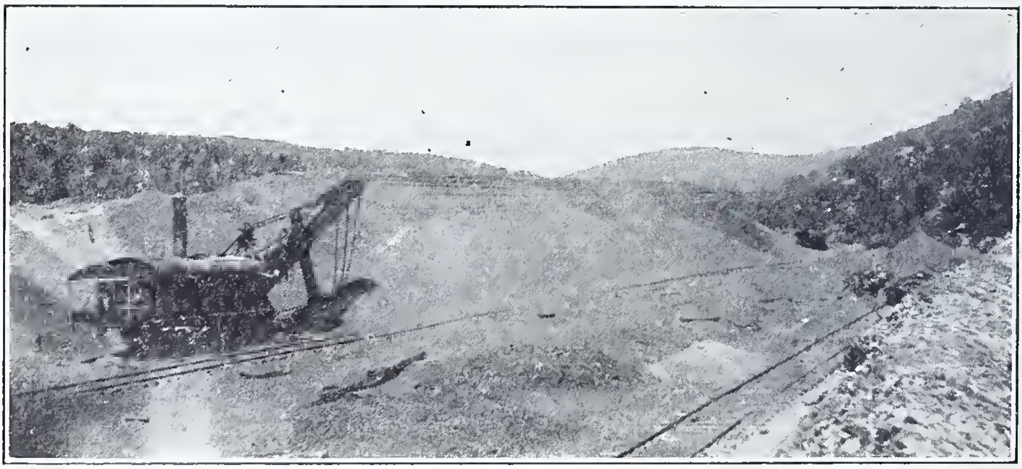
225. *Pennsylvania Coal Co. Inkerman No. 6.*

Location: Inkerman.
Drainage: Into Susquehanna River.

The silt from this colliery is well settled. The bank contains 300,000 tons. Some wash from this bank goes into the river. The culm pile has been worked over three or four times, and that remaining has no value.

PLATE XXV

A. Ravines in old bank at No. 6 Colliery, Pennsylvania Coal Company. Erosion works havoc on old unprotected banks.



B. Steam shovel in position to load silt at Edgerton Colliery, Temple Coal Co.

226. *Pennsylvania Coal Co. Ewen Colliery.*

Location: Port Griffith.
Drainage: Into Susquehanna River.

This colliery was inaccessible when visited because of a strike. The breaker water goes into the river.

227. *Hillside Coal & Iron Co. Butler Colliery.*

Location: In Pittstown Township near Dupont.
Drainage: Into Susquehanna River.

The silt from this colliery is well settled. The bank contains 400,000 tons. Some of this bank is washing away during periods

of heavy rains and floods. The culm bank containing 100,000 tons is now being worked by leasing companies. Most of the silt is now flushed into the mine and all of it will be after breaker construction is completed.

228. *Pennsylvania Coal Co. No. 9 Colliery.*

Location: 1 mile northeast of Pittston.
Drainage: Into Susquehanna River.

229. *Lehigh Valley Coal Co. Seneca Colliery.*

Location: Pittston.
Drainage: Into Susquehanna River.

This colliery is trying to save the silt. A good, large silt bank containing 200,000 tons is well dammed up. The culm bank has been worked over. The old Phoenix bank is gone and the Columbia bank is being worked.

230. *Glen Alden Coal Co. Hallstead Colliery.*

Location: Duryea.
Drainage: Into Lackawanna River.

There is no silt bank at this colliery. The water goes directly into the river. An old culm bank has been burned. Some of it is being carted to Diamond washery. A culm bank contains approximately 200,000 tons of material. Formerly the waste water from the breaker drained directly to Lackawanna River, but the washery slush was pumped to a bank.

231. *Suffolk Anthracite Collieries Co. Avoca Colliery.*

Location: Avoca.
Drainage: Into Lackawanna River.

There is no silt accumulation at this breaker. The water goes directly into the river. Some flushing is done down a bore hole. There is no culm and the rock pile contains no good coal.

232. *Lehigh Valley Coal Co. Heidelberg Colliery.*

Location: Avoca.
Drainage: Into Lackawanna River.

The breaker water from this colliery is well dammed up and the silt bank contains 250,000 tons. The water is well spread over the bank before it seeps through the edges. The culm bank has been worked over.

233. *T. F. Quinn Coal Co. Consolidated Colliery.*

Location: Avoca.
Drainage: Into Lackawanna River.

The silt bank is well banked up and contains 200,000 tons. The culm bank has been worked over and no good coal remains. The bank belongs to Scranton Electric Company.

234. *Pennsylvania Coal Co. Central Colliery.*

Location: 1 mile south of Old Forge.
Drainage: Into Lackawanna River.

There is no silt bank at this colliery. The water goes directly into the river. The culm bank is worked over and contains no good coal. Formerly the silt was flushed into the mine through a bore hole.

235. *Powell-Jennings Coal Co. Rocky Glen Colliery.*

Location: Rocky Glen Park, 1 mile southeast of Moosic.
Drainage: Into Lackawanna River.

The drainage from this colliery goes direct to Lackawanna River without settling. The rock pile contains some good coal. There is no culm pile.

236. *Pennsylvania Coal Co. Old Forge Colliery.*

Location: At Old Forge.
Drainage: Into Lackawanna River.

The breaker water is not settled. It goes directly into the river. The old culm bank has been washed and no coal remains. Formerly all the waste water was used for flushing inside the mine.

237. *Jermyn & Company. Jermyn Colliery.*

Location: Old Forge.
Drainage: Into Ascension Brook.

The breaker water goes directly into Ascension Brook. There is no silt bank. The culm bank has been worked over and the refuse contains no good coal. The rock pile is also barren of coal.

238. *Dennington Washery.*

Location: Old Forge.
Drainage: Into Ascension Brook.

This washery is working over the old Sibley dump. It contains 100,000 tons. A large quantity of good coal is being obtained. The wash water goes directly into Ascension Brook.

239. *Scranton Anthracite Coal Co. Oak Hill Colliery.*

Location: Minooka.
Drainage: Into Lackawanna River.

The water is fairly well settled in a basin. Some silt goes into the river. The rock pile contains no good coal. There is no culm bank.

240. *Glen Alden Coal Co. Taylor Breaker.*

Location: Taylor.
Drainage: Into Lackawanna River.

There are no facilities for settling the breaker water at this breaker. It goes directly into the stream. The culm bank has been worked over and the refuse contains very little coal. There is no coal in the rock pile.

241. *Hudson Coal Co. Greenwood Colliery.*

Location: Minooka.
Drainage: Into Lackawanna River.

The water is settled on a bank, and some goes into the Lackawanna. A culm bank on this property is large, but no estimate of its tonnage could be made. The silt was formerly sent to Marvine for preparation.

242. *W. Y. Moffat Coal Co. Carleton Colliery.*

Location: 1 mile east of Minooka.
Drainage: Into Stafford Meadow Brook.

The water from this colliery seeps through old workings into the Lackawanna. Some silt is discharged. There is no equipment for recovering silt. There is no culm, and the rock pile contains no good coal.

243. *Black Diamond Washery.*

Location: 1 mile east of Taylor.
Drainage: Into Lackawanna River.

Working old Diamond culm pile, which contains 50,000 tons. The silt is settled fairly well in a pond containing 20,000 tons.

244. *John Gibbons Coal Co. Gibbons Colliery.*

Location: At south Scranton city line.
Drainage: Into Lackawanna River.

This is a stripping operation. The rock pile contains some good coal. There is no culm bank. The silt is fairly well settled on a bank. Some goes into the river.

245. *Glen Alden Coal Co. Pine Colliery No. 7.*

Location: Taylor.
Drainage: Into Ascension Brook.

The water from this breaker goes down the creek. No attempt is made to settle it and there is no silt bank. An old culm pile has been worked over and now contains no good coal.

246. *Glen Alden Coal Co. Archbald Colliery.*

Location: Taylor.
Drainage: Into Ascension Brook.

The breaker water is settled in a tank, and the silt scraped onto a bank. Some silt goes into the river. There is at least 300,000 tons of silt in the basin. The old culm pile has been worked over. The rock bank contains some good coal and may be workable in the future.

247. *Glen Alden Coal Co. Continental Colliery.*

Location: 1 mile north of Hyde Park.
Drainage: Into Lackawanna River.

This mine is on fire. A culm bank has been formed by loading out the partly burned coal. No estimate of the tonnage was made. Formerly this breaker was dry and there was no drainage to Keyser Creek nor was any mine water pumped out of the workings.

248. *Glen Alden Coal Co. Baker Colliery.*

Location: Hyde Park.
Drainage: Into Lackawanna River.

The silt from this breaker is settled. The silt bank contains approximately 300,000 tons. The culm pile has been worked over. The rock pile contains 2 to 3 per cent of good coal.

249. *Peoples Coal Co. Oxford Breaker.*

Location: Scranton.
Drainage: Into Lackawanna River.

The breaker water is not settled, and goes directly into the river. The culm pile has been worked over and contains very little good coal. The rock bank contains no good coal.

250. *Glen Alden Coal Co. Hyde Park Colliery.*

Location: Hyde Park.
Drainage: Into Lackawanna River.

This breaker has a settling tank. Some silt goes into the river when the tank overflows. The silt is mixed with barley coal and is used in the boiler plant. There is no culm on the property.

251. *Scranton Coal Co. Capouse Colliery.*

Location: 1½ miles north of central Scranton.
Drainage: Into Lackawanna River.

The coal is prepared at Dickson City. A pile of silt and culm containing approximately 70,000 tons has been worked over once but another attempt is being made to work it. Some of this material is being washed into streams during floods.

252. *Glen Alden Coal Co. Diamond Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

At this colliery the breaker water is settled in a settling pool. The writer was not allowed access to the property and no estimate could be made of the quantity of silt there. A large culm bank has been worked but still contains some good coal. The rock pile contains no good coal.

A washery is taking culm from the culm pile of Diamond Colliery. They have a fairly well built up settling area which contains 50,000 tons of silt.

253. *Lackawanna Fuel Co. Ransome Colliery.*

Location: 2 miles northwest of Hyde Park.
Drainage: Into Lackawanna River.

No culm or silt is accumulated at this locality.

254. *Mid City Coal Co.*

Location: In Scranton between Hyde Park and Providence.
Drainage: Into Lackawanna River.

No culm or silt deposit. All loaded out for lack of storage space.

255. *South Penn Collieries Co. Von Storch Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

The wash water from this colliery goes directly into the creek and the fine sizes are wasted. Some of the silt is used for inside flushing. The culm pile is small and partially worked. 25,000 tons of unworked material remain. The rock pile contains no good coal.

256. *Providence Coal Co.*

Location: Providence.
Drainage: Into Lackawanna River.

This colliery gets its coal from Brisbin culm banks. No provision is made for settling the wash water and all the fine sizes go into the creek.

257. *Scranton Coal Co. West Ridge Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

This colliery has no surface rights and the refuse is hauled away.

258. *Legitts Creek Anthracite Co. Legitts Creek Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

The silt from this colliery has been used for flushing. Some of it goes into the river. The culm pile has been worked over. The rock pile is large but there is no good coal in it.

259. *Hudson Coal Co. Marvine Colliery.*

Location: In the northeast end of Scranton.
Drainage: Into Lackawanna River.

This breaker is using a Dorr thickener for its wash water. The drainage water goes into Lackawanna River, and at times it looks very black. The rock pile has no good coal in it. There is no culm which is accessible.

260. *Scranton Coal Co. Richmond No. 3 Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

The breaker at this colliery has been torn down. There is no surface accumlation except a small rock pile which contains no good coal.

261. *Hudson Coal Co. Manville Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

The coal from this shaft is now taken to Marvine colliery and the breaker has been torn down. The old culm and silt bank has been worked over and the remains of it have little value.

262. *Green Ridge Coal Co. Green Ridge Slope.*

Location: In central Scranton.
Drainage: Into Lackawanna River.

This breaker has been abandoned and the old dump is being used by the Scranton Light and Power Company. It is practically all used.

263. *Scranton Coal Co. Mt. Pleasant Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

This is a dry breaker. Everything is shipped. Loose silt goes back into the mines. The rock is walled up inside the mine. The culm pile has been partially worked over. 50,000 tons remain.

264. *Scranton Coal Co. Pine Brook Colliery.*

Location: Scranton.
Drainage: Into Lackawanna River.

All the breaker water is used for inside flushing. An old culm bank has been partly worked and partly burned. About 35,000 tons remain and it contains much good coal.

265. *Roaring Brook Coal Co. Roaring Brook Colliery.*

Location: South end of Dunmore Boro.
Drainage: Into Roaring Brook.

No coal is preparaed here now. There is no silt or culm.

266. *Reichter Coal Co.*

Location: South of Dunmore Boro.
Drainage: Into Roaring Brook.

No attempt is being made to settle the silt from this small colliery. There is no culm and the rock dump contains no good coal.

267. *Pennsylvania Coal Co. Pennsylvania No. 5 Colliery.*

Location: Dunmore.
Drainage: Into Roaring Brook.

There is no accumulation of silt on the outside. The culm has been worked over and the rock pile contains no good coal.

268. *Carney & Brown Coal Co.*

Location: Dunmore Boro.
Drainage: Into Roaring Brook.

This breaker is dry, and the Scranton Electric Company buys up all the small size coal, silt included. There is no culm bank and the rock pile contains a very small percentage of coal.

269. *Pennsylvania Coal Co. Pennsylvania No. 1 Colliery.*

Location: Dunmore Boro.
Drainage: Into Lackawanna River.

Some of the silt from this breaker is used inside the mine. The remainder is drained out onto a bank which contains 250,000 tons. Some of the silt goes into the river. The culm bank was used during the war.

270. *Meadowside Coal Co.*

Location: Dunmore Boro.
Drainage: Into Roaring Brook.

This is a dry breaker. There is no silt or culm accumulation. The Scranton Electric Company buys all the small sizes. The rock pile is no good; even bone is ground up and sold.

271. *Spencer Coal Co. Spencer Colliery.*

Location: Dunmore Boro.
Drainage: Into Roaring Brook.

The silt from this breaker is well settled on a bank which contains 150,000 tons. A culm bank containing 100,000 tons looks good, and a small cut has been made in it.

272. *Nay Aug Coal Mining Co.*

Location: Dunmore Boro.
Drainage: Into Roaring Brook.

The water from this breaker is well settled on a bank. It contains from 75,000 to 100,000 tons. There is no culm bank, and the rock pile contains very little good coal.

273. *Pennsylvania Coal Co. Underwood Colliery.*

Location: 2 miles northeast of Dunmore Boro.
Drainage: Into Lackawanna River.

The slush from this breaker is filling in a big swamp which probably contains 300,000 tons. There is no culm and the rock bank contains 2 to 3 per cent coal.

274. *Price Pancoast. Pancoast Colliery*

Location: Throop.
Drainage: Into Lackawanna River.
No culm or silt deposit at this colliery.

275. *Glen Alden Coal Co. Storrs Colliery.*

Location: Dickson City.
Drainage: Into Lackawanna River.

The silt from this breaker was used by the Scranton Anthracite Briquet Co., which has ceased operating. Probably 100,000 tons of silt remain. All the water goes directly inside for flushing but is still black when it is pumped into the river.

276. *Scranton Coal Co. Johnson Colliery.*

Location: Dickson City.
Drainage: Into Lackawanna River.

The silt from this breaker is being used for flushing. The water is pumped out again into the river. A small culm pile is being used for boiler fuel. The rock pile probably contains 2 to 3 per cent coal.

277. *Hudson Coal Co. Eddy Creek Colliery.*

Location: Olyphant.
Drainage: Into Lackawanna River.

No coal is being prepared at this breaker. The water formerly went into Lackawanna River and no attempt was made to settle it. An old culm bank, partly burned, has been partly worked. A large quantity remains, probably 300,000 tons.

278. *Hudson Coal Co. Olyphant Colliery.*

Location: Olyphant.
Drainage: Into Lackawanna River.

The wash water is used for flushing inside the mines. When it is not needed some of it goes into the river. There is no culm pile, and the rock bank contains only 2 to 3 per cent of coal.

279. *Lackawanna Collieries Co. Lackawanna Colliery.*

Location: Peckville.
Drainage: Into Lackawanna River.

This is a dry breaker and the coal is washed in railroad cars. All the silt goes directly into Lackawanna River. There are 450,000 tons of culm. Much of it is burned over and mixed with ashes.

280. *Scranton Coal Co. Ontario Colliery.*

Location: Peckville.
Drainage Into Millers Creek.

The silt from this breaker is well stored. There are 150,000 tons of good material in the bank. A 200,000 ton bank of fine coal mixed

with rock is leased to the Barton Coal Co. The waste water carries some coal into the creek and the bank run-off water is not well clarified.

281. *Scranton Coal Co. Raymond Colliery.*

Location: Peckville.
Drainage: Into Lackawanna River.

Coal from Raymond colliery is being shipped run-of-mine to Ontario breaker. The small culm and silt accumulations are combined with Rhondda Colliery.

282. *Radiant Coal Co. Rhondda Colliery.*

Location: ¼ mile northwest of Winton.
Drainage: Into Lackawanna River.

The silt at this colliery is fairly well settled. A large bank is gradually being built up and contains approximately 150,000 tons. It is being worked intermittently. The culm bank, which contains 200,000 tons, was being worked in 1925.

283. *Scranton Coal Co. Riverside Colliery.*

Location: 1 mile southwest of Archbald.
Drainage: Into Lackawanna River.

The silt is being partly recovered at this colliery and 30,000 tons have accumulated. There is no culm pile and the rock bank contains no good coal.

284. *Humbert Coal Co. Sunnyside Colliery.*

Location: 2 miles east of Sterrick Creek Colliery, and 1½ miles east of Jessup.
Drainage: Into Grassy Island Creek.

The slush from this breaker is being accumulated in a small well-built-up bank, but settlement is not very effective and a considerable quantity of fine silt is carried into the stream. A small culm pile, containing 50,000 tons, looks good, and is not being worked.

285. *Temple Coal Co. Sterrick Creek Colliery.*

Location: Jessup.
Drainage: Into Grassy Island Creek.

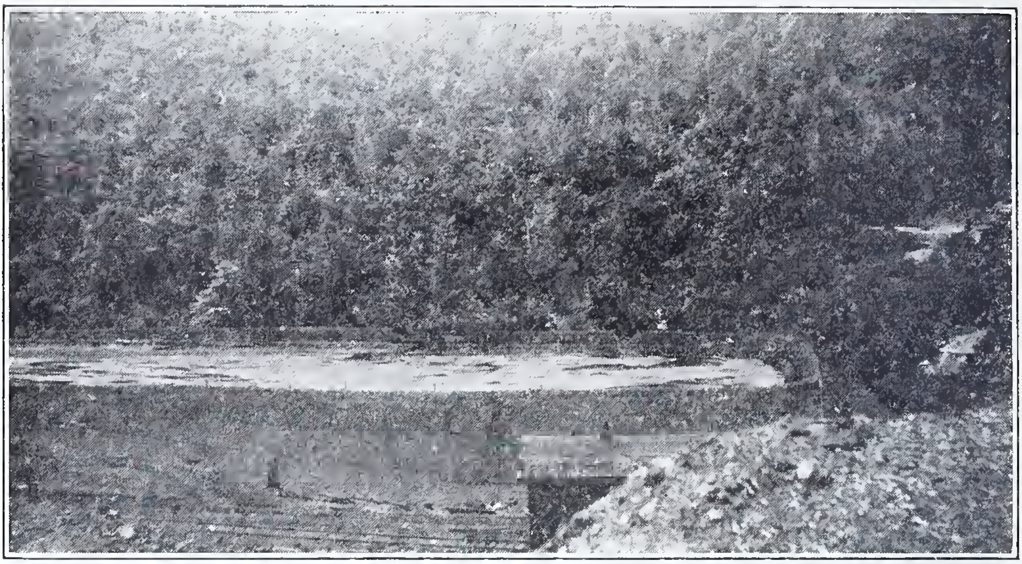
No silt is being accumulated at this colliery. The water goes directly into the stream or is used underground. The culm bank is on fire and it is impossible to estimate its tonnage.

286. *Mt. Jessup Coal Co. Mt. Jessup Colliery.*

Location: Jessup.
Drainage: Into Lackawanna River.

This colliery uses all the silt inside. There is no culm.

PLATE XXVII



A. New bank at Sunnyside Colliery. An ideal settling bank. Note boards in position as retainers.

B. Sunnyside Colliery, Humbert Coal Co. New silt bank. The hole in the lower left corner is where a sample was taken.

287. *Winton Coal Co. Winton Colliery.*
Location: Jessup.
Drainage: Into Lackawanna River.

The water from this colliery goes directly into Lackawanna River, and there is no silt accumulation. The culm bank has been partly worked and 200,000 tons remain.

288. *Suffolk Anthracite Collieries Co. Rose Washery.*
Location: Jessup.
Drainage: Into Grassy Island Creek.

This washery prepares coal for other companies. The silt is not collected. This property has a culm bank containing 150,000 tons.

289. *Hudson Coal Co. Gravity Slope Colliery.*

Location: $\frac{3}{4}$ mile south of Archbald.
Drainage: Into Lackawanna River.

The silt is being settled on a bank but some of the water goes into the river before it is thoroughly settled. This bank contains 150,000 tons. A washery is connected with the colliery and all fines are recovered. A very rich culm pile containing 175,000 tons is not being worked, although thousands of tons have been shipped from it. The culm came from the old dry breaker from coal which was mined many years ago.

290. *Suffolk Anthracite Collieries Co. Tappan Colliery.*

Location: 1½ miles northeast of Archbald.
Drainage: Into White Oak Run.

There is no silt or culm at this breaker. The water goes directly into the stream. The rock pile contains no good coal. Formerly slush and waste water were flushed to a bank surrounded by rock. This bank drained back into the mine.

291. *Hudson Coal Co. Jermyn Colliery.*

Location: Jermyn.
Drainage: Into Lackawanna River.

This breaker is not being used. Formerly the silt was flushed into the mines. A washery was operated at this colliery and prepared thousands of tons of culm for the market. Approximately 200,000 tons of culm are left. A silt bank containing at least 200,000 tons is still intact.

292. *Ammerman Coal Co. Fireside Colliery.*

Location: 1 mile northwest of Jermyn.
Drainage: Into Rush Brook.

The coal is shipped run-of-mine, and no silt is being produced. The rock pile accumulated when the breaker was running contains no good coal. There is no culm.

293. *Hillside Coal & Iron Co. Erie Colliery.*

Location: $\frac{3}{4}$ mile southwest of Carbondale.
Drainage: Into Lackawanna River.

This colliery is shipping coal run-of-mine to Dunmore. There was once a large culm pile here but it has been worked over and only a part of it remains. This part is now being worked. Silt is not being produced.

294. *Hudson Coal Co. Powderly No. 2 Colliery.*

Location: ½ mile southwest of Carbondale.
Drainage: Into Lackawanna River.

Formerly the silt from this breaker, which is wet, was pumped back into the mines, but now the silt is allowed to drain directly into Powderly Creek. The culm and rock banks are being washed at the breaker. Approximately 200,000 tons of this material remain.

295. *Sunrise Coal Co. Sunrise Colliery.*

Location: On Fall Brook ½ mile northwest of Carbondale.
Drainage: Into Fall Brook.

No coal is prepared at this mine and it was not visited.

296. *Fallbrook Coal Co. Fallbrook Colliery.*

Location: 1 mile northwest of Carbondale.
Drainage: Into Fall Brook.

The breaker water goes directly into the stream, and the silt does not accumulate. The culm pile has been worked over, and the rock bank contains no good coal.

297. *Lackawanna Coal Corp. Falls Colliery.*

Location: 1½ miles northwest of Carbondale.
Drainage: Into Fall Brook.

This is a small operation and there is no accumulation of culm or silt.

298. *Suffolk Anthracite Collieries Co. Boland Colliery.*

Location: 1 mile south of Carbondale.
Drainage: Into Powderly Creek.

The silt from this breaker is not settled. Formerly it went into a swamp, but this swamp is now filled and the water goes directly into the creek. The culm has been loaded out.

299. *Racket Brook Coal Co. Racket Brook Colliery.*

Location: 1 mile east of Carbondale.
Drainage: Into Lackawanna River.

The breaker water goes directly into the stream. There is no culm or silt, and the rock pile contains no good coal.

300. *Hudson Coal Co. Coal Brook Colliery.*

Location: Carbondale
Drainage: Into Lackawanna River.

The breaker water goes directly into the river and no attempt is made to settle the silt. The large culm pile, which has never been worked, contains 225,000 tons of material. The rock pile contains no good coal.

301. *Murray Coal Co. Murray B Colliery.*

Location: 1½ miles northeast of Carbondale.
Drainage: Into Lackawana River.

The breaker water goes directly into the stream. There is no silt bank or culm pile. The rock bank contains no good coal.

302. *Suffolk Anthracite Collieries. Nay Aug No. 2 Colliery.*

Location: East bank of Lackawanna River, 2 miles north of Carbondale.
Drainage: Into Lackawanna River.

The breaker water goes directly into the river. No silt is settled. An old culm bank has been worked over and contains very little coal. The rock bank contains no good coal.

303. *Wilson-Hill Coal Co. Franklin Colliery.*

Location: 2 miles northeast of Carbondale.
Drainage: Into Elk Creek.

The breaker water goes directly into the stream. There is no silt bank. The rock pile contains no good cool. An old culm pile has been worked over but some coal may be gotten out of it. The contents of this bank are problematical.

304. *Richmondale Coal Co. Richmondale Colliery.*

Location: 2 miles southwest of Vandling.
Drainage: Into Elk Creek.

The wash water goes directly into the stream and is not settled. There is no culm pile and the rock bank contains no good coal.

305. *Temple Coal Co. Northwest Colliery.*

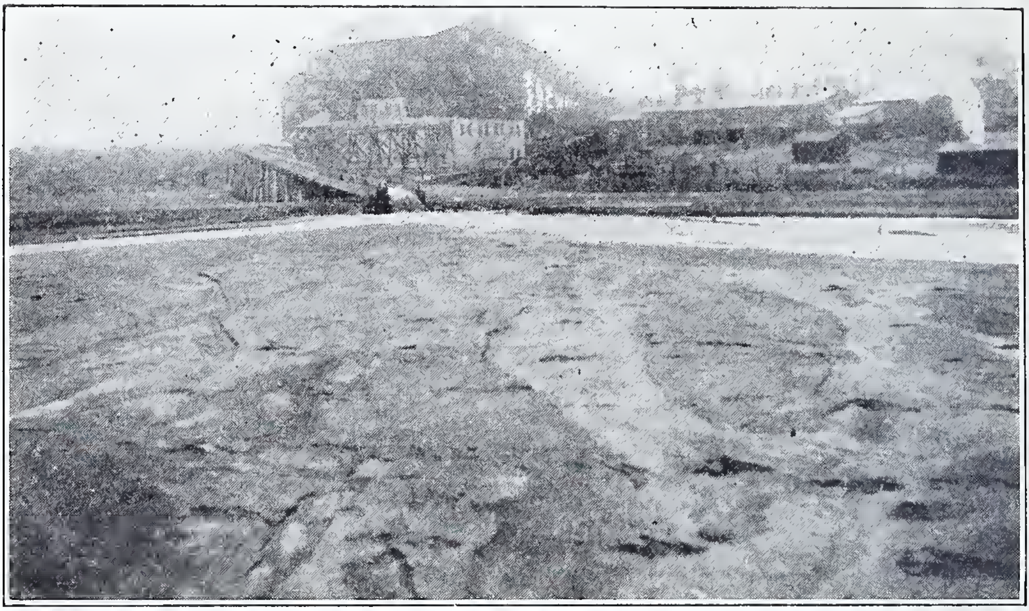
Location: 3 miles east of Carbondale.
Drainage: Into Lackawanna River.

The breaker water goes directly into the stream. No attempt is made to settle it, therefore there is no silt. The rock pile contains no coal, and the old culm bank has been worked over.

306. *Red Haven Coal Co. East Side Mine.*

Location: East bank of Lackawanna River, 2 miles north of Carbondale.
Drainage: Into Lackawanna River.

This is a very small dry breaker which works intermittently and has very little discharge.



A. Forest City breaker and silt flume. To illustrate how silt is delivered to a silt bank.

B. Lower silt basin at Underwood Colliery, Pennsylvania Coal Co., looking toward silt delivery end from roadway. The water spreads over the entire bank.

307. *Hudson Coal Co. Clinton Colliery.*

Location: At Vandling, midway between Forest City and Carbondale.

Drainage: Into Lackawanna River.

This breaker has a large silt bank containing 100,000 tons. It is well built up with dry silt and very little fine-sized coal goes into the river. All sizes below pea coal are run through a washery at the colliery. There is no culm bank.

Formerly, much of the silt was used for inside flushing, and the material which was not used went over an improvised slush bank directly into the river. The rock bank contains no good coal.

308. *Hillside Coal & Iron Co. Forest City No. 2 Colliery.*

Location: Forest City.
Drainage: Into Lackawanna River.

This breaker has a silt bank containing approximately 100,000 tons. It was originally run into a depression. This depression is now filled and the bank is being well built up as the silt accumulates. Very little silt goes into the river. A washery is attached to the breaker and all the fine sizes are recovered. The rock pile contains no good coal. There is no culm bank.

309. *Clifford Coal Co. Clifford No. 1.*

Location: 2 miles north of Forest City.
Drainage: Into Lackawanna River.

This breaker is abandoned. The coal is prepared at Moosic. There are no silt or culm accumulations. Formerly a washery known as the Clifford Washery of the Pennsylvania Coal Company was located near this site. The slush from this washery was discharged into a depression from which an old culm bank had been removed. This accumulation of silt also has been removed.

RIVER AND CREEK COAL

The three rivers draining the anthracite fields, the Susquehanna, Schuylkill, and Lehigh, have been carrying away thousands of tons of combustible material annually for over a hundred years. When anthracite mining was in its infancy there was no demand for small sizes. The steam sizes which are now so popular were piled outside the mines and were gradually washed into the streams. In addition to these steam sizes, pea and nut coal were often discarded. These accumulations were the basic source of river coal. Anthracite was first prepared dry. Later in the growth of the anthracite industry, water was used for preparing the coal and enormous quantities of domestic sizes were washed directly into the streams through the medium of breaker water discharge. Twenty years ago the streams of the anthracite region contained millions of tons of coal. These accumulations and the accumulations on breaker properties have gradually been worked over and are disappearing. Some old culm banks belonging to "Company" coal producers have not been reworked but these banks have been overgrown by tough grass, weeds, and small trees which find sufficient food in the piles to grow prolifically. This vegetation protects these old piles. During times of high water the creeks run over the top of silt and culm accumulations. The greatest migration of coal takes place during freshets. Large accumulations of silt disappear down the creeks during one freshet. New bars are built up from material which is washed down from above. Conditions are changing however, and there is very little doubt that the river coal industry will eventually cease.

History. Before 1890 the accumulations of silt along the creek and river banks were worked only by private individuals who shoveled up enough of the best and largest material for use in their stoves. The first operations on a commercial scale were in the vicinity of Harrisburg. A short time later operations were started near Sunbury. The first recorded appreciable production of river coal was in 1891 when sand and gravel producers reported production of river coal as a by-product of their other business. For 15 years the river coal industry was sporadic, and very small quantities were removed for use in nearby communities. There was little demand for the product because bituminous coal was cheap and residences and commercial plants were not equipped with the grates and blowers necessary for burning the fine coal.

Domestic sizes recovered from the creeks before they left the anthracite region were sold to householders for $2.00 a ton. The smaller sizes brought 50 to 75 cents a ton.

From 1905 to 1910 river coal gained in popularity on the Susquehanna and power companies began to use it in their plants. The production grew and in 1913, 260,000 tons were produced. The price ranged from $1.00 to $1.25 per ton; $3.00 to $3.50 was charged for domestic sizes.

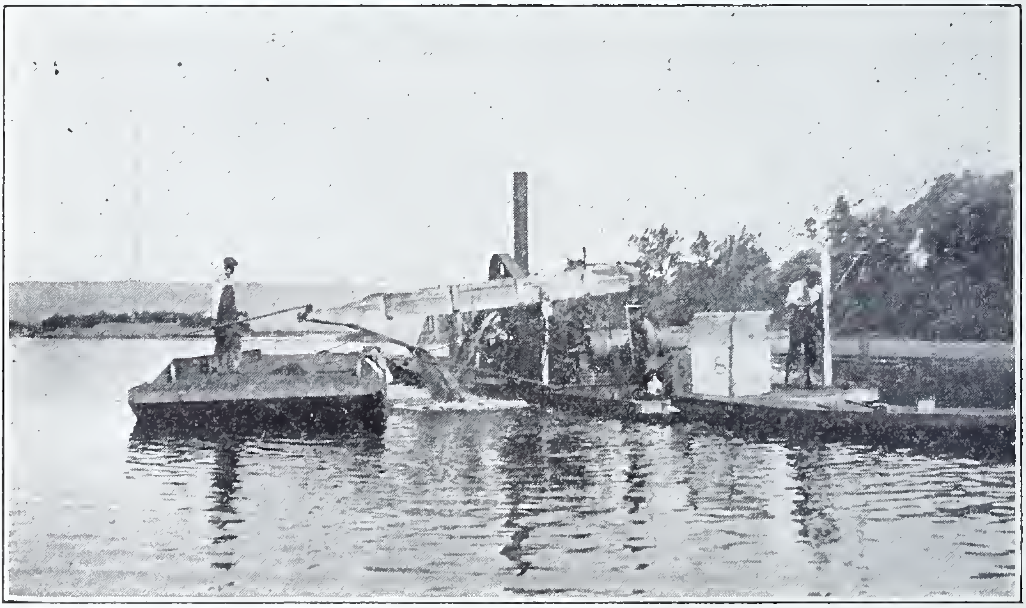
Migration and accumulation of river coal. River coal is separated from sand and gravel by Nature which uses the well-known physical fact that when a mixture of heavy and light material is moved through the agency of water, the lighter material, which in this instance is coal, moves faster. Deposition takes place with the sand and heavy

FIGURE 19
Occurence of River and Creek Coal.

material such as bone on the bottom, and relatively pure coal on top. Many factors cause variation in this general law. The larger pieces of coal, of course, move much more slowly than the smaller pieces. Most of the larger pieces are recovered in the creeks before they reach the river. The small pieces move onward and form bars and shoals in the rivers and creeks. The very finest of the material

PLATE XXVIII

A. River coal on flat boats above Harrisburg. Waiting to be towed to unloading dock.



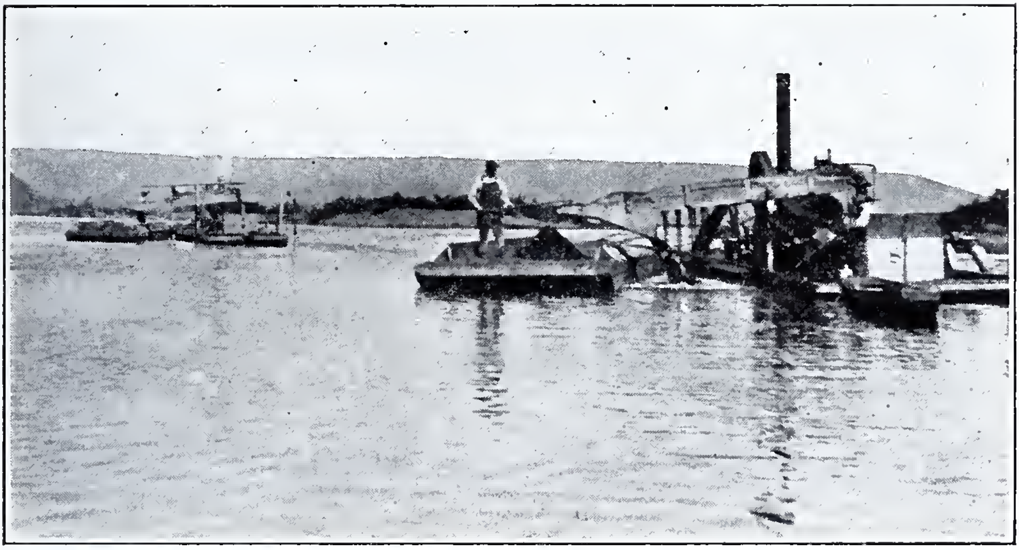
B. Mechanical separation of the coal from sand and water.

is suspended in the water and is carried rapidly to the sea. Small particles of coal can be seen in the waters of the Susquehanna at Havre de Grace, Maryland. Ice cakes in that locality contain pieces of anthracite.

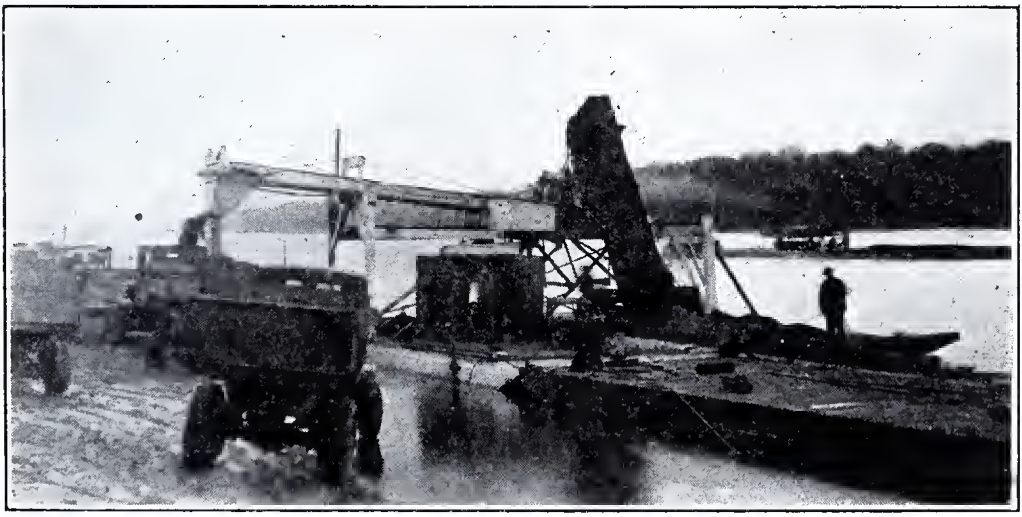
The travel and accumulation of river coal is not constant. The coal is deposited where the current is sluggish. Freshets scour out new channels and the swifter water changes its course. The same material may be moved from side to side in a stream valley without much forward movement. On the other hand a bar may be lifted entirely and moved down the stream by high water and ice. Com-

paratively large sand bars disappear completely in two or three days and new ones are built up. Observations of a coal and sand bar in the vicinity of Heckton, Dauphin County, indicate that it moved southward three miles in one year. This coal bar was composed of material 50 per cent of which passed through 3/32 inch round mesh screen. This is approximately the average size of the

PLATE XXIX



A. River coal dredge and stern wheel steamer at Harrisburg.



B. Unloading river coal from flat boat by mechanical digger and delivery to truck, near Harrisburg.

anthracite which is being recovered from the river at Harrisburg. At the rate of movement of three miles in one year, it would take the coal 20 years to move from Lykens to Harrisburg, and 30 years from Shamokin to Harrisburg. This assumes, of course, that the rate of movement is constant. The coal would move faster on the creeks in which it originates because the current is swifter. Some coal bars in the Susquehanna do not move for several years. Others move very rapidly. After careful thought and consideration of all

the factors which are involved, it is reasonable to believe that river coal of average size or approximating that of No. 4 buckwheat which passes a 3/32 inch round mesh screen, will move between 2 and 3 miles a year. The finer material will move more rapidly and the larger material less rapidly. It is reasonable to assume that material which is being recovered from the river at Harrisburg in 1927 was mined in the Lykens Valley 20 or 25 years ago, and in the Shamokin Valley 30 or 40 years ago.

Methods of recovery. The smaller tributaries of the rivers are in most places too narrow, shallow, or swift for the use of floating outfits such as pumps and dredges. The most popular method for recovering coal in these creeks is entirely by hand. In some localities a conveyor bucket chain lifts the coal from the creek up onto a small loading table. The coal is shoveled by hand into the buckets.

At one place on Shamokin Creek a small washery was erected for the purpose of recovering a very large accumulation. The creek coal was carried to this washery by a scraper line and by hand loading. There is very little river and creek coal recovered today entirely by manual labor. Some small operators along the creeks recover a few tons of coal for local consumption. After a freshet considerable piles of domestic-sized anthracite are accumulated for local use. This material is mixed with pebbles, chunks of wood, and other undesirable material. It does not make the best domestic fuel.

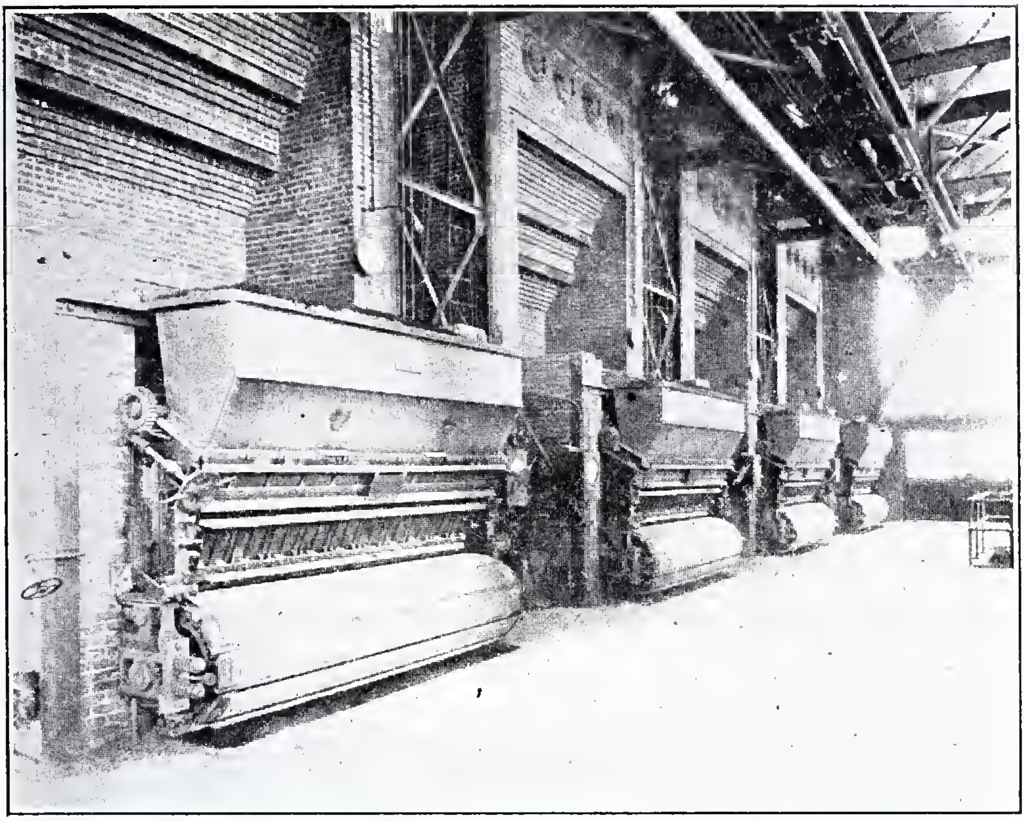
Practically all the river coal is now recovered by rotary pumps which are permanently installed on the banks or on floating barges. The larger producers own a fleet of several flatboats which are moved back and forth under their own power to the most desirable localities. After each freshlet the Susquehanna River at Harrisburg is a new Eldorado. As soon as it is safe to navigate, the fleets of boats hastily leave their moorings and go in search of the most desirable deposits. The lucky ones reap the greatest harvest. The mixture of coal and sand pumped out of the river is separated in a very rough manner by passing over screens mounted on the dredge. These improve the quality of the product by retaining the corser coal and returning the sand to the river. Some of the companies have been doing some special screening but the results do not justify the increased cost of production.

The recovery of river coal is seasonal and the quanity obtained depends upon the number of freshets during the year. In Harrisburg river coal was in great demand during 1926 and the first part of 1927. A number of freshlets provide excellent recovery conditions.

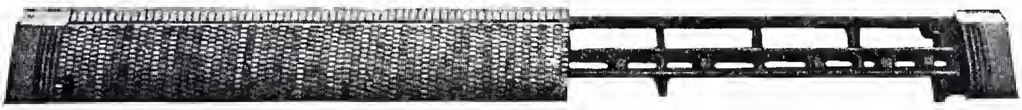
In former years several thousand tons of domestic-sized anthracite was recovered yearly from the creeks draining from the anthracite region. This part of the industry is almost disappearing.

Use of river and creek coal. Practically all the river coal is used by commercial plants for generating power and for briquetting. Thousands of tons are used each year for generating electricity in the vicinity of Harrisburg. Very little other coal is used for this purpose.

River coal must be burned by forced draft on equipment designed for the burning of fine-sized anthracite. Practically all the grates



A. Coxe stokers under 612 h. p. boilers at Cornell University.



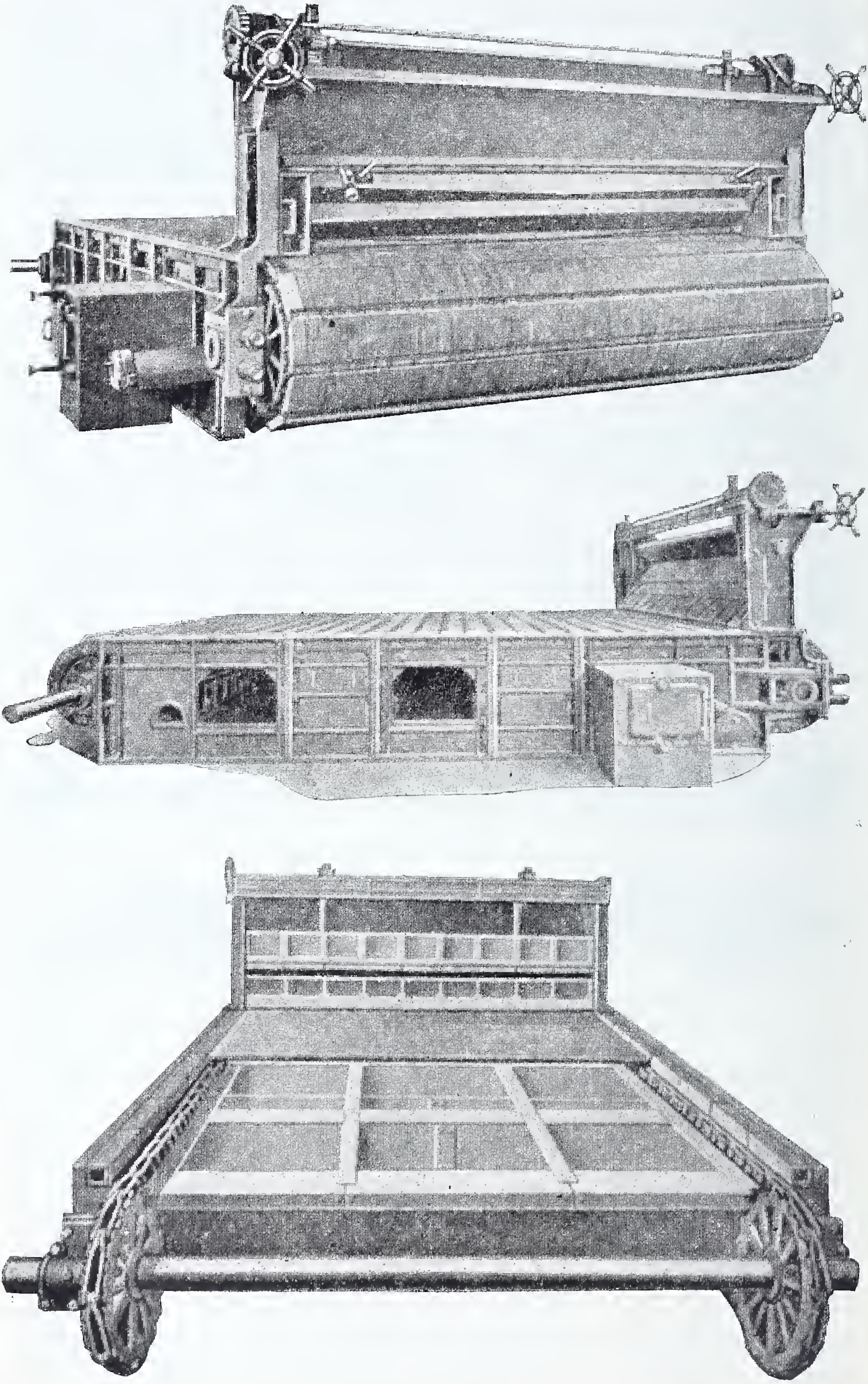
B. Detail of bar showing method of attaching keys.

C. Coxe stoker grate keys.

which are used are of the Coxe travelling grate type. Plate XXX pictures the construction of this grate.

This stoker consists of the main body, the grate, the driving gear, and the hopper. There are two sectional cast iron side frames about 3 feet in height and of varying length, depending on the length of active fire which is required. These frames are provided at the rear end with pedestal bearings to hold the rear or driving shaft, and at the front end with take-up grates for the front or idler shaft bearings. In the side frames are openings corresponding to the forced draft air connections and other openings for the removal of dust or siftings which accumulate during a period of time. Under the active portion of the grate is built a box of sheet steel, the bottom of which is about 10 inches from the bottom of the frames.

PLATE XXXI



Front, side, and rear views of Coxe stoker.

This allows sufficient space beneath for the return travel of the grates. At the front end and vertical side or end of the air box is a cast iron plate which extends the full length of the stoker. This serves as an air seal and as a carrier of the grate bearings. At the rear end of the air box is a similar vertical plate and horizontally sealed plate; between these plates is the active grate surface. There are 2 or 3 lateral trunks or air boxes built into the side frames at their ends, and closed on the bottom by the bottom sheet and on the top by a cast iron sealed plate to the same level as the front and rear sealed plates. The plate is, however, somewhat narrower than the front and rear plates. Its width is about equal to the distance between the ribs of the adjacent carrier bars. Each compartment contains 2 or 3 tuyeres or air boxes. Midway between the tuyeres is another vertical partition with a sealed plate at the upper end which divides the under grate section into 4 or 6 compartments communicating with the under side of the grate. Grid valves or gates are provided in the vertical side of the tuyeres and for the full length of the stoker to distribute air from the tuyeres or boxes. Both the stationary grate and the sliding member are ground to insure a tight fit when they are closed. The sequence of compartments for a two tuyere stoker from the front to the rear is (1) an air compartment, (2) a tuyere with a sliding damper which controls the air to the first compartment, (3) a second compartment which takes the air through the rear side of the front tuyere, (4) a vertical partition, (5) a third air compartment, (6) a second tuyere, (7) another air compartment.

The Coxe stoker is driven through the rear shaft through a pair of worm and stem gears, the larger of which is located at the end of the stoker shaft which passes through the side wall. The worm of this gear is driven by a shaft which is in turn driven by a second worm and wheel gear which is usually placed behind the boiler. The drive is continuous, silent and without shock.

The grate surface consists of a number of narrow castings about 5/8 inches wide, flat on one side, and having on the other a number of projections about 3/32 inches high which separate these fingers or keys at that distance. The keys are slightly curved on their top edge. They are strung on malleable iron dove-tails which in turn are bolted to a carrier bar. These bars which are of skeleton type extend the full length of the stoker and terminate in solid ends on the underside where steel bar lugs engage drop forged chains which convey the bars around.

The first essential for good combustion in a river coal fuel bed is uniform resistance so that the air will be evenly distributed, thus avoiding an excessive quantity at one point and insufficient at another. The coal must be of fairly uniform size and evenly distributed on the grate. In the Coxe stoker the grate surface is so designed that fine streams or jets of air of uniform size are admitted through the grate. The fuel bed is of uniform thickness at the entering point and along any line parallel to the front of the stoker. The total resistance of grate and fuel bed is also uniform. As the coal is burned the resistance of the fuel bed decreases toward the rear of the grate, and if the entire grate were under the same air pressure obviously most of the air would pass through the

central fire at the end of the grate where it was least required. By means of multiple air compartments it is possible to vary the pressure under the different portions of the grate in accordance with the thickness of the fuel bed above each compartment. Hence a uniform fire can be maintained over the entire grate. If necessary only one-half or three-fourths of the grate may be used for combustion. The rear compartment can be closed to draft which makes it possible to burn the coal at a higher rate of combustion on the front portion of the stoker and thus maintain the necessary high temperatures required for ignition.

In most installations the ashes fall off the rear end of the stoker as it rotates into a pit. This pit is flooded with water or the ashes are removed by conveyor. River coal is not of uniform size and constant variation of draft is necessary. Large pieces cause dark spots in the fire and where the material is extremely fine forced draft makes blow holes through the fire bed. The finer the coal the less is the efficiency and also the greater the quantity of ash. If the coal is too fine it is blown through the flues and into the ash pit. With river coal as it is being produced today quick combustion is the most efficient. The heating value of river coal has not changed although the sizes which are recovered are much smaller than those 5 years ago. Much of the discussion of the use of river coal was taken from the publications of Combustion Engineering Corporation. Mr. Lee Coleman, combustion engineer of the Harrisburg Light & Power Company, furnished additional information.

Susquehanna River area. Susquehanna River and its tributaries drain the entire Northern Anthracite Field, part of the Eastern Middle Field, all of the Western Middle Field, and part of the Southern Field. All of the silt-laden water flows into the Susquehanna River north of Harrisburg with the exception of Swatara Creek which enters the Susquehanna at Middletown. The beds of the creeks are heavily overlain with deposits of silt, and the river bottom is lined with silt bars.

The first recovery of coal in the Susquehanna drainage area was in the river itself. Recovery of coal from creek beds did not start until 1915 when coal was in great demand and the price of soft coal had increased to high levels. Since 1916 numerous operations, some of which were not permanent, have been installed on Wiconisco, Mahanoy, Shamokin, and Swatara creeks and on the North Branch of the Susquehanna. The coal recovered from the creeks is practically all used near-by. Some of the coal recovered from the river is shipped to distant points, but most of its is used in the vicinity of Sunbury and Harrisburg. On Wiconisco Creek the Pennsylvania Railroad is accessible for shipping at Millersburg near the mouth of the creek, and at Dornsife, Elizabethville, and Loyalton. Other points along the creek are inaccessible to the railroad and even at the points where the railroad is close to the creek, transportation is expensive because the railroad grade is approximately 50 feet above the creek level. The creek coal operations on Wiconisco Creek are now confined to the vicinity of Elizabethville.

The coal from Mahanoy Creek can be shipped either by the Reading or Pennsylvania Railroads to Herndon at the mouth of the creek,

on the Reading at Dornsife Station, and at Hunter Station. These are the only points on Mahanoy Creek where large operations can be successfully conducted. Four well established concerns are operating on Mahanoy Creek. This creek contains large quantities of silt and is a fertile source for material which flows into Susquehanna River.

Shamokin Creek flows through the open country between Shamokin and Sunbury. It is flanked on one side by the Philadelphia & Reading and by the Pennsylvania Railroad on the other. Short side tracks from both railroads are available and shipping facilities are good. Large accumulations of silt are being worked extensively in the vicinity of Sunbury and Deibler, Reed, and Shamokin. There are extensive creek coal operations at Gordon and Barry. The accumulations at this point are large and the shoals are a fruitful source of good material. A briquetting plant is being contemplated at Gordon.

The Delaware, Lackawanna & Western follows the west bank of the North Branch of the Susquehanna and the Pennsylvania the east bank. These two railroads offer good shipping facilities to river coal operations between Sunbury and Pittston. The active operations along this branch are at Klines Grove, Danville, Armedia, Espy, Hecks Ferry, and Plymouth.

The most extensive operations in river coal are on the main Susquehanna between Sunbury and Pequea. Two dozen or more companies are operating in this area. Coal is recovered at Sunbury for briquetting. At Herndon coal is recovered for local use and for shipment. At Clarks Ferry coal is dredged and some of it loaded for shipment, and some is trucked to Harrisburg. River coal operations are carried on practically continuously from Clarks Ferry to New Cumberland except where the current is too swift or the river is not deep enough to operate flat boats. The next extensive operation to the south is at York Haven. At Columbia and Marietta two or three companies are operating successfully. The most southern operation is at Pequea. Silt accumulations occur in large quantities as far south as the State line but they have not been worked, probably because they are far from a point of consumption and the sizes are prohibitively small.

Swatara Creek drains a large anthracite mining territory and has carried away thousands of tons of silt. Below Jonestown, Swatara Creek becomes winding and comparatively sluggish and before it reaches Middletown it has deposited practically all of its coal burden. At Hummelstown there is little coal along the banks or in the shoals. The water is discolored but it is said that fish have been living in this creek up to this point. Small hand operated plants have been recovering creek coal intermittently in the vicinity of Green Point. This coal contains a large percentage of domestic sizes. In fact, Swatara Creek offers the only virgin dredging territory. Parts of the creek have not been dredged extensively because they are distant from any point of consumption and there are no railroad facilities. Thousands of tons of coal can be recovered from this creek bottom.

Schuylkill River area. Schuylkill River drains a large territory in the vicinity of Pottsville. Many large breakers are located on its drainage area. As a result enormous accumulations of silt have been deposited between Pottsville and Reading. Silt deposits are present practically all the distance between Pottsville and the Montgomery County line. Indications of silt can be seen as far as Philadelphia. All of the dredging operations in this river are between Pottsville and Reading. Between these two towns the river is flanked by the Pennsylvania and Reading railroads. Transportation facilities are good. Practically all the coal taken from Schuylkill River is reclaimed by rotary pumps mounted on flat boats as in the Harrisburg district. Some half dozen companies are operating on this river and remove much coal each year. Schuylkill River seems to replenish its coal supply very rapidly. One company operating 1 mile south of Schuylkill Haven has worked for four years in an area which does not exceed 4,000 feet along the river. They have removed many thousands of tons of coal and at no time were they compelled to suspend operations for lack of it. The operations on the Schuylkill are small compared to those on the Susquehanna and its branches. Water conditions are not favorable for pumping at a great many points. Hand mining is possible because of the large accumulations along the river bank and in the fields. These deposits will eventually be worked over.

Lehigh River area. The Lehigh River drains only a small part of the anthracite field and obtains practically all its silt from Nesquehoning Creek. Operations of river-coal plants are very sporadic on this river and only a small tonnage is recovered each year. In the vicinity of Mauch Chunk and further south the Lehigh Coal & Navigation Company dredges some coal out of the old canal bed. This company reclaimed 100,000 tons of coal in 1919 but has made no report since that time. One or two other operations work intermittently and produce but a small tonnage.

Statistics of production. Approximately 10,000,000 tons of coal have been recovered from the rivers and creeks draining from the anthracite field. The greatest production was 1,935,000 tons in 1919. This great demand was created by the shortage of coal caused by a prolonged coal strike. Production went back to normal again in 1921 and has shown very little decline. The following table gives production statistics for 1921-1925,* inclusive.

Production of river coal in Pennsylvania, 1921-1925

	No. of operations	No. of employees	Expenses and wages	Capital investment	Tons	Value
1921	50	388	$ 318,800	$1,058,300	502,920	$ 717,700
1922	61	617	551,100	1,578,400	887,041	1,316,200
1923	61	613	555,000	1,694,100	911,371	1,114,400
1924	47	524	508,200	1,432,700	763,460	906,600
1925	46	446	556,100	1,225,300	791,920	908,000

*Pennsylvania Department of Internal Affairs, Bureau of Statistics.

Production of river coal, by counties, in 1925.

County	No. of operations	No. of employees	Expenses and wages	Capital investment	Tons	Value
Berks	4	25	$ 39,400	$ 78,800	48,985	$ 63,200
Columbia	4	8	4,100	30,000	10,669	12,000
Dauphin	12	230	274,100	374,100	307,244	372,400
Lancaster	2	18	32,200	108,500	65,738	84,100
Lebanon	1	4	2,500	19,000	4,626	7,800
Luzerne	1	20	20,700	100,000	64,593	67,800
Montour	2	2	700	5,500	1,740	3,100
Northampton	1	5	10,100	16,000	36,176	41,700
Northumberland	11	85	107,900	331,600	155,799	215,000
Schuylkill	7	32	36,300	115,300	66,605	86,500
York	1	17	28,100	46,500	29,745	44,400
	46	446	$556,100	$1,225,300	791,920	$998,000

Future of the river coal industry. There is diverse opinion among river coal operators as to the life of the river coal industry. This industry does not depend entirely upon supply. It is an economic condition which is governed more or less by market conditions. In all probability, market conditions would be favorable enough to continue river coal operations for a great many years, particularly on the Susquehanna, but the supply of river coal is not inexhaustible. During the last few years the anthracite-producing companies are making a serious attempt to recover all the fine sizes of anthracite. Some companies are now letting No. 4 buckwheat go into the stream but not wilfully. The source of river coal larger than No. 4 buckwheat has been eliminated. Large quantities of No. 4 buckwheat and slush are discharged into the stream and this will afford some supply for the future. Nevertheless, even this supply is greatly diminished. The creeks will gradually clean their channels and wash additional material into the streams. River dredging will be carried on in the Susquehanna area for 25 years or more. The industry will die a natural death and a time will come when it will not be profitable to dredge for coal alone. River coal will again be a by-product of the sand and gravel industry.

There seems to be a large supply of river coal on Schuylkill River. This coal is on the flood plains of the river and is increased each year. The river stays in its channel and leaves these deposits practically unmolested. The river coal industry can be carried on for many years on the Schuylkill.

Lehigh River is not such a fruitful source for silt and its possibilities will become less and less in the future. The collieries which have been supplying the river with its silt are now conserving the very smallest of sizes.

Quality and size of river coal. River coal decreased gradually in size until 1922-23. During this period there was a decided decrease in the percentage of large sizes. This may be indirectly traced to the suspension of mining in 1919 with the subsequent demand for river coal. During this period the better accumulations were worked over. From 1923 to 1927 the size of river coal has not decreased to any great degree. At Harrisburg 50-65 per cent of the coal goes through 3/32 inch round mesh. Below Harrisburg 80 per cent goes

through 3/32 inch mesh. An average size analysis of river coal at Harrisburg is as follows:

	Per cent
Over 3/16	6.5
Through 3/16, over 3/32	25.85
Through 3/32, over 1/16	42.65
Through 1/16	25.00

In the years 1926-27 there has been some complaint about the quality of river coal. As the sizes become smaller it is more difficult to separate the sand from it. The quality of the coal itself has not depreciated. As the size of the coal decreases the quality will become worse and worse. The quality depends almost entirely upon the care which is taken in preparation.

Seven freshets of the Susquehanna in 1927 brought down a large quantity of coal, and the river coal industry flourished. The coal was 10 per cent larger than in 1926. Eighty per cent of it passed through a 3/32 inch screen. The increase in size is due to better preparation methods, and the large number of freshets.

River coal is unique in that it offers a profitable recovery of a waste material. It is the only natural material which has been wasted in the State and recovered after a long time. River coal has been beneficial to the communities along the creeks and rivers in which it occurs, and many profitable industries have been founded because of its presence. It has afforded cheap power and light to Harrisburg for a great many years.

River Coal Producers in Pennsylvania

Company	Office Address	Works Address	County
Alleman, Grant E. (Drifted Coal & Supply Co.,	Shoemakersville,	Shoemakersville,	Berks.
Anthracite Dredging Company, 247 Wyoming Ave.,	Kingston,	Plymouth,	Luzerne.
Anthracite Production Co.,	Pequea,	Shenks Ferry,	Lancaster.
Auburn Drifted Coal Co.,	Shoemakersville,	Auburn,	Schuylkill.
Bevenue Coal Company,	Marysville,	Marysville,	Perry.
Bestecki, Baron, 315 Walnut St.	Harrisburg,	Clarks Ferry,	Dauphin.
Blue Mountain Coal Co.,	Hamburg,	Hamburg,	Berks.
Brown, Charles,	New Cumberland,	Herdon,	Northumberland.
Custer, C. E.,	Almedia,	Almedia,	Columbia.
Davis, C. C., 315 Sixth Street,	New Cumberland,		Cumberland.
Daft, Harry,	Marietta,	Columbia,	Lancaster.
Deibler Coal Co., 435 Commercial Trust Bldg.,	Philadelphia,	Deibler,	Northumberland.
Downey, F. H., 1329 S. Cameron St.,	Harrisburg,		Dauphin.
Ebersole, John M., P. O. Box 388,	Reading,	Tuckerton,	Berks.
Ebony Coal Co., 621 E. Dewart St.,	Shamokin,	Shamokin,	Northumberland.
Etmoyer, R. J.,	Highspire,		Dauphin.
Filling, W .H., 1335 N. 6th St.	Harrisburg,		Dauphin.
Fisher, C. Arthur,	Orwigsburg,	Landingville,	Schuylkill.
Fordham & Co., B. W.,	Treverton,	Dornsife,	Northumberland.
Forney, Chas. E.,	Danville,		Montour.
Franklin Coal & Coke Co., 1600 Walnut St.,	Philadelphia,	Barry,	Schuylkill.
Gordon Company,	St. Benedict,	Gordon,	Schuylkill.

Company	Office Address	Works Address	County
Hess, Luther,	Espy,	Espy,	Columbia.
Hoffman, Reese & Son,	Almedia,		Columbia.
Hoover Coal Co.,	Dornsife,	Dornsife,	Northumberland.
Huff, Wm. H.,	New Cumberland,	New Cumberland,	Cumberland.
Industrial Coal Co., 422 Bridge St.,	New Cumberland,		Cumberland.
Kulp Coal Co.,	Shamokin,	Reed,	Northumberland.
Landingville Coal Co. (Bechtel & Nichter),	Pottsville,	Pottsville,	Schuylkill.
Line Mountain Coal Co., 910 Franklin Trust Bldg.,	Philadelphia,	Dornsife,	Northumberland.
McCreath, R., 565 Race St.,	Harrisburg,		Dauphin.
McGready Krout & Company,	York Haven,		York.
Mackennan & Hatch Co., The,	Herndon,	Herndon,	Northumberland.
Mahanoy Valley Coal Co., 106 E. Chestnut St.,	Shamokin,	Girardville,	Schuylkill.
Martin Construction & Supply Co., 135-45 N. 10th St.,	Harrisburg,	Harrisburg,	Dauphin.
Meadow Hill Coal Co., 430 Scranton Life Bldg.,	Scranton,	Herndon,	Northumberland.
Mengel, Uriah H.,	Auburn,	Auburn,	Schuylkill.
North Branch Dredging Co., Susquehanna Ave.,	Sunbury,	Sunbury,	Northumberland.
Port Clinton Coal Co., c/o Frank M. Master, Calder Bldg.	Harrisburg,	Port Clinton,	Schuylkill.
Robbins Brothers,	Bloomsburg,	Hicks Ferry,	Luzerne.
Scranton Bayonne Coal Co., 128 Wyoming Ave.,	Scranton,	Hunter (Dornsife),	Northumberland.
Scranton Electric Co., 509 Linden St.,	Scranton,	Butzback,	
Scranton Fuel Co., 308 Union Bank Bldg.,	Scranton,		
Schuylkill Haven Drifted Coal Co., P. O. Box 554,	Schuylkill Haven,	Schuylkill Haven,	Schuylkill.
Seebold, C. C.,	Riverside,		Northumberland.
Shamokin Anthracite Reclaiming Co., 604 Colonial Trust Bldg.	Reading,	Klines Grove,	Northumberland.
Shamokin Valley Coal Co., 102 Franklin Bank Bldg.,	Philadelphia,	Deibler, Paxinos, Reed,	Northumberland.
Shissler, Ed.,	Camp Hill,		Cumberland.
Slider & Erb,	Elizabethetown,	Marietta,	Lancaster.
Sneidman Brothers,	Almedia,	Almedia,	Columbia.
Steward, Ray E., 1403 N. Front St.,	Harrisburg,	Harrisburg	Dauphin.
Stewart, M. B.,	West Fairview,	West Fairview,	Cumberland.
Stroh, Crist and Fred, 3218 Green St.,	Harrisburg,		Dauphin.
Sturtevant & Hetherland Coal Co.,	Elizabethville,		Dauphin.
Summerville, A. H., 117 Wall St.	New York, N. Y.	Barry,	Schuylkill.
Susquehanna Dredging Co.,	Columbia,		Lancaster.
Thompson Coal Co.,	Auburn,	Auburn,	Schuylkill.
Treichler Drifted Coal Co.,	Shoemakersville,		Berks.
Weston-Dodson & Co., Inc., 528 N. New St.,	Bethlehem,	Deiblers (2 plants)	Northumberland.
Zeigler Coal Co., F. A.,	Elizabethville,	Elizabethville,	Dauphin.

SAMPLING SILT AND CULM BANKS

Introduction

Before undertaking the extensive sampling campaign required to obtain a comprehensive idea of the character of silt and fine coal deposits in the anthracite field, it was deemed advisable to do some preliminary work on methods of sampling.

At a conference of engineers and representatives of various companies, held in Wilkes-Barre on January 16, 1926, various methods were proposed and discussed at length but no specific procedure was fixed upon as giving promise of precise results at a practicable cost. Driving pipes to obtain a core sample was generally regarded as inaccurate because of plugging of the pipes, and the use of augers would have the disadvantage of breaking the coal. Moreover either of these two methods would be too expensive, considering the limited funds available for carrying on the work.

The most economical procedure suggested may be called surface or horizontal sampling, consisting of sinking test pits into the top and sides of the bank, so distributed as to represent, as nearly as possible, equal quantities of material, and the side pits penetrating the cribbing which was built up to retain the silt. This, with some modification, was the plan finally adopted after a month of preliminary work to compare the samples so obtained with those taken by more precise methods.

Method of sampling

The sampling procedure followed throughout the work was as follows:

(1) A preliminary reconnaissance was made of the deposit to be sampled and locations were selected for individual sample increments to represent equivalent quantities of silt as nearly as could be estimated. In large banks of somewhat symmetrical shape this was done by spacing sample locations at centers of square 50 to 150 paces on a side depending upon size and nature of the deposit. Where banks were irregular in plan and thickness, the effect of such irregularities was compensated for, as nearly as could be estimated, in making up the composite sample. In deep banks the lower layers were represented in estimated proportion by samples taken on sides after digging through the drift or surface material accumulated from above. Advantage was also taken of any vertical sections exposed by cuts or washouts, which were found in many of the deposits sampled. Portions of banks that differed markedly in composition or history were sampled separately.

(2) At each selected location, a core sample was taken with a 3-inch galvanized iron tube forced down into the deposit by turning and pushing. When the tube was inserted as far as possible by

the weight of the operators, it was withdrawn, the core removed, and the tube reinserted in the hole for another section of core, care being exercised to prevent scraping the sides of the hole. In the usual silt deposit, which is sufficiently damp for the particles to cohere, these sample holes stood clear and open and no difficulty was experienced from caving; except in a very few cases where the material was barley and rice coal, or larger, practically free from fines. From 4 to 10 insertions of the tube were required to obtain a 10-foot core, depending upon the compactness of the bank, which was usually an indication of its age. In the early part of the work a 4-foot tube was used but this was later supplemented by a 10-foot tube and 10-foot cores were obtained at most of the banks. The various individual samples were combined and reduced by coning and quartering to a suitable size for drying—25 pounds was adopted for ordinary silt banks containing a small percentage of barley and rice coal.

Factors Affecting Precision of Sampling

Various conditions may affect the accuracy of results obtained by any sampling method and, as these conditions vary greatly among individual deposits, each presents a separate sampling problem. If the accumulations were geometrical in shape or uniform in character throughout, samping would be simple; but it is unlikely that these conditions ever exist. Most of the deposits sampled were irregular in shape and the contour of the ground under the deposit could, in most cases, be ascertained only approximately. This made the correct allocation of sample holes difficult and at best, only approximate.

Wide variations in the physical and chemical character of material through the deposit is to be expected and this factor determines the number and spacing of individual samples required to make a representative composite.

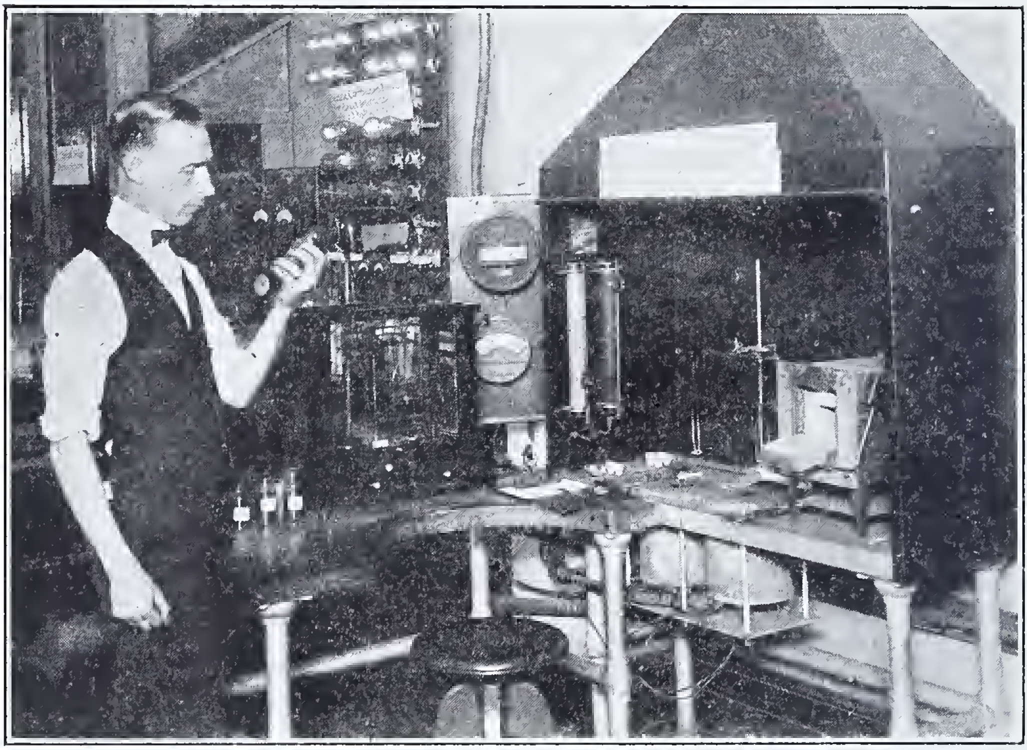
The distribution of sizes and impurities in a deposit of silt must depend largely upon the history of the mine, the preparation plant, and the deposit itself, during the period of accumulation. Changes in character of coal mined, method of preparation, size of screens used, or method of transporting silt to the bank will have been reflected in the make-up of the deposit as it accumulated; and it is also subject to rearrangement by the elements after deposition.

In the month of preliminary work, a study was made of the variation in character of silt in the bank and its effect on precision of surface sampling, at two collieries where special facilities were available. The banks studied contain small proportions of barley and rice coal.

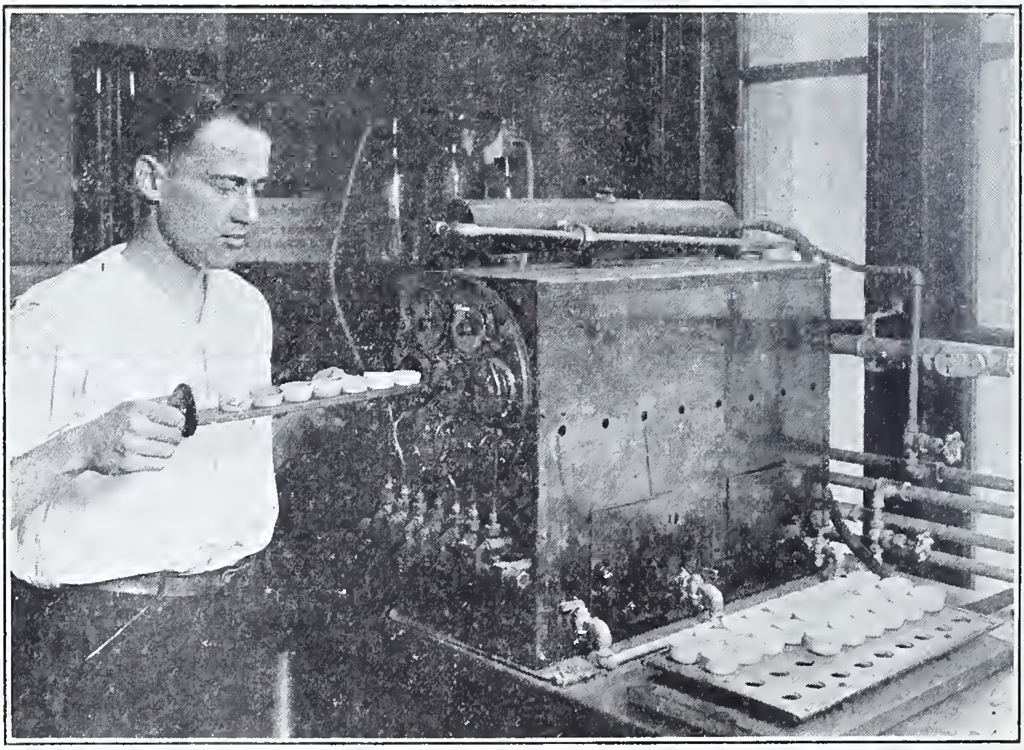
Examination of Samples

The composite bank samples were dried in the sun or on drying pans in the colliery coal inspector's laboratory and then reduced by a standard Jones riffle sampler to a size suitable for screening to obtain the percentage of each size in the bank. A set of 12 inch 3/64 inch, and square mesh wire screens as follows: 50 mesh, 100 mesh, and 200 mesh.
round sieves was used for this purpose. This set contained round hole screens of the following sizes: 11/16, 9/16, 5/16, 3/16 3/32, and

PLATE XXXII



A. Furnace for the determination of volatile matter of coal.



B. Drying oven for the determination of moisture content of coal. Both pictures are in the laboratories of the United States Bureau of Mines at Pittsburgh.

The preliminary study of sampling methods and the factors that affect the precision of results, was made at Mocanaqua colliery of the West End Coal Company, and at the Ontario colliery of the Scranton Coal Company.

Chemical analyses and determination of heating value (B. t. u.) were made in the laboratory of the Pittsburgh station, United States Bureau of Mines with the equipment shown in Plates XXXII and XXXIII.

Mocanaqua Colliery Silt Bank

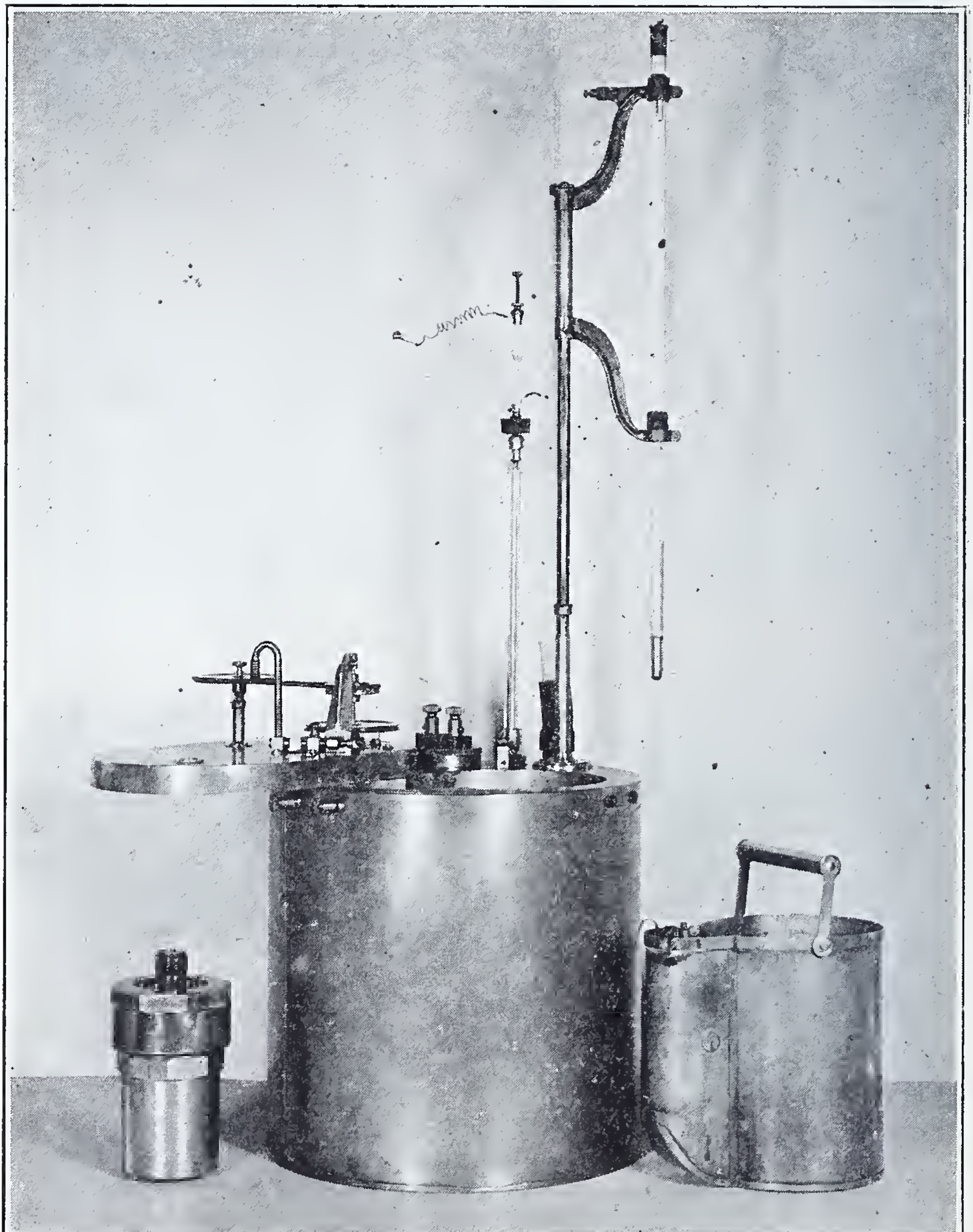
The Mocanaqua colliery is located at the town of Mocanaqua on Susquehanna River opposite Shickshinny. The silt bank at this colliery is especially suited for the preliminary study because it is of moderate size and contains a recently made cut which exposed the entire vertical section of the exterior of the bank so that it could be channel sampled. A separate conical portion of the bank being made at the time of sampling could be sampled separately by the surface sampling method for comparison with the mean of a series of daily samples of current silt being deposited upon it. This small bank contained the silt produced during the six months operating period immediately preceding the date of sampling. It contained approximately 4,000 tons of silt.

This conical bank of new and current silt was built up by conveying the silt to the top by a scraper line and flushing it out onto the pile with a small quantity of water. Silt from the breaker is conveyed by flume to a settling tank from which a perforated bucket elevator picks it up and delivers it to the drag line conveyor. The finest perforations in the screens through which this silt passes are 1/16 inch in diameter, but during a large part of the time No. 4 buckwheat, made through 1/8 and over 1/16 inch round holes also goes to the bank. This was the practice at the time of sampling.

The main part of the bank which was deposited prior to installations of the settling and dewatering tank was built up by flushing the silt out over it with water and impounding it in marginal banks built up of silt with sluiceways for draining off the water. Two of the commonest methods of storing silt are therefore represented in this bank. The main bank is roughly rectangular in shape and is approximately 550 feet long by 200 feet wide. It ranges in thickness from about 70 feet at the upper or east end of the intake to about 10 feet at the western extremity.

Lateral distribution of sizes. Surface samples were taken on the top and sides of this bank and three composite samples were made; one represented the upper or inflow end of the bank, one represented the middle section, and another represented the lower or downstream end in order to show the lateral variation in size of material. Screen analyses of these three samples and of the composite of channel samples taken in the shovel cut which penetrates the bank are given in the following table. While this shows a slightly larger percentage of the largest size in the inflow sections of the bank there was no outstanding decrease in size of material from the inflow end toward the opposite extremity. This is accounted for in part by the fact that a large part of the sluice escaped with the run-off

PLATE XXXIII



Calorimeter for determining the heating value of coal at the Pittsburgh Station, United States Bureau of Mines.

water when the bank was being deposited and to the fact, as indicated by old flume remains, that the stream was directed in a body to various parts of the surface and the stream did not always fan out entirely from the surface end.

Table 1. Comparison of screen analyses of samples of three sections of bank and in shovel cut at Mocanaqua Colliery.

Size		Per cent of total sample									
Through	Over	1st section*		2nd section		3rd section		Mean**		Shovel cut	
		Direct	Cumulative	Direct	Cumulative	Direct	Cumulative	Direct	Cumulative	Direct	Cumulative
----------	3/16	1.5	1.5	.4	.4	1.2	1.2	1.0	1.0	0.5	0.5
3/16	3/32	15.5	17.0	16.8	17.2	21.6	22.8	18.0	19.0	10.6	11.1
3/32	3/64	30.8	47.8	34.5	51.7	31.4	54.2	32.2	51.2	30.1	41.2
3/64	50	28.5	76.3	30.1	81.8	26.2	80.4	28.3	79.5	35.7	76.9
50	100	15.2	91.5	12.4	94.2	12.4	92.8	13.3	92.8	16.8	93.7
100	200	5.4	96.9	3.7	97.9	4.3	97.1	4.5	97.3	4.3	98.0
200	----------	3.1	100.0	2.1	100.0	2.9	100.0	2.7	100.0	2.0	100.0
Total		100.0		100.0		100.0		100.0		100.0	

*Surface samples along side of shovel cut (on each side).
**Mean of three preceding sections.

These three sectional screen analyses and the proportion of fines (through 30 mesh screen) in various individual samples taken over the top of the bank showed only unmethodical irregularity of distribution of sizes. This is in marked contrast to many banks examined later in which the silt-bearing stream enters at one end and meanders through or spreads out over the bank. In such deposits, particularly where the sluice is almost completely retained, there is a very observable downward gradation in size toward the downstream end and in many cases the extreme end of the bank is so mucky as to render tube sampling difficult. Proper location of sample increment over the area of the deposit is very important in such a case. In banks that thin out toward the downstream end this was accomplished by taking samples on lines across the bank at right angles to the stream, the spacing being inversely proportional to the estimated thickness.

Vertical distribution of sizes. To show how the material might vary in size from top to bottom of the deposit the channel samples taken in the cut which opens up this bank, were taken in consecutive benches, each of ten feet vertical thickness and separate samples of each bench were kept. This cut extends into the side of the bank a distance of 100 feet or approximately to the center and it is about 60 feet wide. Channel samples were taken from top to bottom in the middle of the back of the banks and in the middle of each side.

The samples were taken by squaring up the face in the vicinity of the sample location, removing the exposed face to a depth of about six inches and for a width of two feet and then taking a uniform channel sample about 8 inches wide by three inches deep down the middle of the cleared section. Each individual sample was examined for ash and fines (through 80 mesh screen) and a composite sample of each horizontal 10-foot bench was made up for screen analysis.

These screen analyses are presented in table 2. These figures show a somewhat higher proportion of fines in the lower part of the bank than in the upper part but the difference is not very great except in the proportion of very fine material through 200 mesh.

This increase of fines with depth is perhaps explainable as due to the washing of fines from the upper into the lower part of the bank by the water that was continually flushed out upon the bank as new material was added, and by rains. No change in size of screens has been made in the preparation plant during the accumulation of the deposit.

At the time of sampling the faces of the cut stood at an angle of about 70 degrees from the horizontal except for the lower 10 feet, where fallen material had accumulated. This was shoveled away to expose the normal stratified deposit before sampling.

Table 2. Comparative screen analyses of bench samples taken in shovel cut at Mocanaqua Colliery.

Size		Direct and cumulative analysis given for each bench Percent of total sample													
Thru	Over	Top bench		2nd bench		3rd bench		4th bench		5th bench		Bottom bench		Mean	
------	3/16	0.7	0.7	1.1	1.1	0.8	0.8	------	------	0.3	0.3	0.2	0.2	0.5	0.5
3/16	3/32	16.4	17.1	17.0	18.1	12.7	13.5	4.6	4.6	5.6	5.9	7.6	7.8	10.6	11.1
3/32	3/64	36.0	53.1	37.4	55.5	33.6	47.1	21.7	26.3	23.7	29.6	28.0	35.8	30.1	41.2
3/64	50	30.3	83.4	30.2	85.7	32.8	79.9	42.3	68.6	40.3	69.9	38.6	74.4	35.7	76.9
50		16.6	100.0	14.3	100.0	20.1	100.0	31.4	100.0	30.1	100.0	25 6	100.0	23.1	100.0
Total		100.0		100.0		100.0		100.0		100.0		100.0		100.0	

Table 3. Percent of ash and fines in individual samples on each side of shovel cut.

Bench	North side		South side		Mean	
	Ash	Fines	Ash	Fines	Ash	Fines
1 (Top)	19.0	16.8	18.2	15.7	18.6	16.2
2	16.1	17.1	12.5	13.9	14.3	15.5
3	31.9	28.9	19.4	10.1	25.6	19.5
4	21.2	49.2	21.5	65.9	21.3	57.5
5	17.9	47.4	21.5	57.3	19.7	52.3
6 (Bottom)	19.7	53.9	17.0	27.0	18.3	40.4
Mean	21.0	35.5	18.4	31.7	19.6	35.2

Table 4. Percent of ash and fines in individual samples taken in shovel cut.

Bench	North side		Center		South side		Mean	
	Ash	Fines	Ash	Fines	Ash	Fines	Ash	Fines
1 (Top)	20.3	18.9	27.9	39.5	21.0	14.3	23.1	24.2
2	21.0	19.3	24.3	26.3	21.9	25.3	22.4	23.6
3	23.8	49.2	27.3	27.0	19.9	16.2	23.7	30.8
4	25.2	55.7	35.4	43.4	26.5	41.8	29.0	47.0
5	29.0	49.7	31.7	43.6	37.7	45.7	32.8	46.3
6 (Bottom)	25.6	31.9	29.3	35.7	36.8	52.1	30.6	39.9
Mean	24.1	37.9	29.3	35.9	27.3	32.5	26.9	35.4

Similar variations in size with depth is borne out by determination of the proportion of fines (through 30 mesh screen) in each individual sample. This is true both of individual samples taken in the cut and surface samples taken on both sides of the cut. Tables 3 and 4 show the ash content and percentage of fines in these individual samples. There appears to be no methodical variation in ash content.

The surface samples taken along each side of the open cut were so located as to represent by the surface sampling method approximately the same portion of the bank as represented by the channel samples taken on the faces exposed in the cut. Screen analyses of the composite samples obtained by the two methods are given in the first table and in Fig. 21. The cumulative figures show a close check between these samples, indicating that the average size of particles in the two samples was practically the same. The greatest variation in any individual size is in the increments between 3/64 inch and 50 mesh, of which the surface sample contained 28.5 per cent and the channel sample 35.7 per cent, a difference of 7.2 per cent. All other sizes are much closer.

Table 5. Comparison of daily samples of current silt with tube samples of small new part of bank at Mocanaqua Colliery.

Size		Screen analysis			
		Bank sample		Current sample (7 days)	
Through	Over	Direct	Cumulative	Direct	Cumulative
----	3/16	0.1	0.1	0.1	.1
3/16	3/32	13.5	13.6	15.3	15.4
3/32	3/64	33.8	47.4	35.5	50.9
3/64	50	35.9	83.3	34.1	85.0
50	100	12.0	95.3	12.3	97.3
100	200	3.2	98.5	1.9	99.2
200	----	1.5	100.0	.8	100.0
Total	----	100.0	----	100.0	----

Table 6. Daily samples of current silt at Mocanaqua Colliery.

Date	Ash	Through 30 mesh
1926	Per cent	Per cent
May 4	28.5	13.9
5	29.4	18.7
8	30.9	29.3
10	26.6	17.0
11	27.4	35.6
12	25.1	27.1
Composite of above	27.0	21.6

Table No. 5 gives the screen analyses of a composite sample of the new conical bank of current silt taken by the surface sampling method, and of a composite of seven samples of current silt deposited on the bank during a two weeks period. Surface samples were taken with a four-foot tube and each current silt sample was accumulated

by collecting equal small increments at half hourly intervals throughout an operating day from the silt discharge spout delivering from the dewatering elevator to the drag line conveyor. Comparison of the cumulative screen analyses of the two composite samples is shown graphically in Fig. 21. The maximum difference in the proportion of any individual size increment, obtained by screening the two composite samples, is 1.8 per cent in the 3/32 to 3/16 inch size.

Daily variations in the quality of silt are shown by the percentage of ash and of fines in separate daily samples.

Ontario Colliery Silt Bank

The Ontario colliery of the Scranton Coal Co. is at Peckville, near Winton.

The Ontario breaker prepares 1800 to 2000 tons of coal per day. Part of this is fresh mined and part is bank coal. The coal is cleaned by simplex jigs and screened over 3/32-inch round-hole screens. The size of screens has not been changed during the deposition of the bank; but, about four months prior to the date of sampling, an auxiliary silt shaker with 3/32-inch perforations was installed to recover accidental oversize in the silt before it is discharged to the bank.

The silt that passes through this screen is flushed out upon the bank, with water, to be directed to various portions of the bank by an attendant, who also maintains an impounding bank of silt, through which the run-off water is discharged by sluice-ways to a small creek which carries it to Lackawanna River.

Table 7. Per cent of ash and fines in individual samples from bank at Ontario Colliery.

North wing of bank			West wing			East wing			Lower samples			Side samples		
Sample No.	Ash	Fines	Sample No.	Ash	Fines	Sample No.	Ash	Fines	Sample No.	Ash	Fines	Sample No.	Ash	Fines
101	40.1	------	109	24.7	41.4	118	20.2	30.5	106B	40.8	41.2	127	15.3	45.0
102	32.0	30.2	110	33.7	44.9	119	16.4	31.3	C	36.0	28.6	128	12.0	35.6
103	31.2	28.4	111	30.1	39.4	120	16.9	40.0	D	43.7	30.1	129	15.2	47.8
104	28.6	37.7	112	22.1	26.7	121	27.4	24.3	112B	21.8	25.2	130	16.4	43.2
105	31.4	26.1	113	17.5	45.1	122	26.3	26.9	C	------	------	131	17.0	50.1
106	26.7	26.2	114	17.1	45.2	123	21.6	41.1	D	30.8	36.3	132	17.0	37.7
107	20.2	32.7	115	25.3	50.1	124	25.5	47.9	123B	------	------	136	28.3	34.9
108	28.7	31.6	116	18.2	48.2	125	40.1	52.4	C	17.2	37.7	137	39.9	40.3
			117	18.6	44.0	126	51.7	55.9	D	------	------			
Average	29.9	26.6		23.0	42.3		27.3	39.0					20.1	41.8

At the time of sampling the bank was about 3 years old and approximately 25 feet deep.

The three wings of this bank, which are nearly equal in area, were sampled separately by the surface sampling method, and a test pit 16 feet deep was sunk in the center of each wing for bench sampling. Table 7 gives the percentage of ash and the percentage of fines in the individual samples taken over this bank.

Unlike the results obtained at Mocanaqua, these samples show a downward gradation in size of material from the inflow to the overflow end of the bank. There is also an appreciable difference in average ash content, the highest ash samples being obtained at the inflow and the lowest ash samples in the sides of the bank around the overflow periphery.

Variation in size of material with depth. At sample locations 106, 112, and 123, pits were sunk in order to sample down to a depth of 16 feet and 4 foot bench samples below these surface samples are designated by the subscripts B, C, and D of these numbers.

Table 8. Comparative screen analyses in south wing (section 3).

Size		Sample 123A		Samples 123 AB, C & D		Composite of top tube samples	
Through	On	Per cent of total		Per cent of total		Per cent of total	
		Direct	Cumulative	Direct	Cumulative	Direct	Cumulative
	5/16	.8	.8	.5	.5	.3	.3
5/16	3/16	.4	1.2	.6	1.1	.5	.8
3/16	3/32	3.0	4.2	3.5	4.6	3.2	4.0
3/32	3/64	26.6	30.8	26.7	31.3	28.3	32.3
3/64	50	44.7	75.5	42.3	73.6	42.9	75.2
50	100	16.2	91.7	16.8	90.4	17.2	92.4
100	200	5.8	97.5	6.0	96.4	4.6	97.0
200	----	2.5	100.0	3.6	100.0	3.0	100.0
		100.0		100.0		100.0	

Table 9. Comparative screen analyses in north wing (section 2).

Size		Sample 112A		Samples 112ABC & D		Composite of surface tube samples	
Through	On	Per cent of total		Per cent of total		Per cent of total	
		Direct	Cumulative	Direct	Cumulative	Direct	Cumulative
	5/16	.4	.4	.3	.3	.4	.4
5/16	3/16	.6	1.0	.4	.7	.4	.8
3/16	3/32	1.7	2.7	2.7	3.4	2.9	3.7
3/32	3/64	19.8	22.5	27.2	30.6	24.2	27.9
3/64	50	52.0	74.5	43.7	74.3	42.5	70.4
50	100	19.3	93.8	19.6	93.9	18.2	88.6
100	200	3.7	97.5	3.9	97.8	6.7	95.3
200	----	2.5	100.0	2.2	100.0	4.7	100.0
		100.0		100.0		100.0	

Table 10. Comparative screen analyses in inflow wing at Ontario Colliery.

Size		Sample 106A		Samples 106 A B C & D		Composite surface tube samples	
Through	On	Per cent of total		Per cent of total		Per cent of total	
		Direct	Cumulative	Direct	Cumulative	Direct	Cumulative
	5/16	.9	.9	0.3	0.3	1.5	1.5
5/16	3/16	.6	1.5	0.3	0.6	0.3	1.8
3/16	3/32	2.4	3.9	1.9	2.5	1.8	3.6
3/32	3/64	36.0	39.9	28.8	31.3	28.4	32.0
3/64	50	37.6	77.5	44.1	75.4	44.1	76.1
50	100	15.2	92.7	18.2	93.6	16.7	92.8
100	200	4.4	97.1	4.1	97.7	4.6	97.4
200	----	2.9	100.0	2.3	100.0	2.6	100.0
		100.0		100.0		100.0	

Table 11. Comparative screen analyses of bank samples at Ontario Colliery.

Size		Mean of surface samples		Mean of vertical benches		Mean	
Through	On	Direct	Cumulative	Direct	Cumulative	Direct	Cumulative
	5/16	8.8	0.8	.4	.4	0.6	0.6
5/16	3/16	0.6	1.4	.4	.8	0.5	1.1
3/16	3/32	3.3	4.7	2.7	3.5	3.0	4.1
3/32	3/64	28.0	32.7	27.6	31.1	27.8	31.9
3/64	50	41.5	74.2	43.3	74.4	42.4	74.3
50	100	17.0	91.2	18.2	92.6	17.6	91.9
100	200	5.2	96.4	4.7	97.3	4.9	96.8
200	----	3.6	100.0	2.7	100.0	3.2	100.0
		100.0		100.0		100.0	

Tables 8, 9, and 10 give the screen analyses of the surface samples and of the composite channel sample at each pit location and also, the screen analyses of the composite surface sample of the corresponding section of the bank.

These show no methodical variation in size of material with depth although the individual samples show irregular variation. Composite channel samples and composite surface samples of the same section of the bank checked closely on screen analysis. Graphs showing these comparative screen analyses are presented in Figure 21. Curves in Figure 21 show the cumulative screen analyses of a composite surface sample of the entire Ontario bank taken over the top and sides of the bank with a 4-foot tube and of a composite of all the bench or channel samples. The greatest difference in these two samples was in the size through 3/64 inch over 50 mesh which constituted 41.5 per cent of the surface sample and 43.3 per cent of the channel sample, a maximum variation of 1.8 per cent.

These check results and those obtained at the Mocanaqua colliery, indicate that where no great change has been made in the size of screens during the accumulation of a deposit, the surface method of sampling may be expected to represent the bank with a precision of within 5 per cent even when no vertical sections are available for bench sampling. In sampling very old banks, where changes in size of smallest screens or other radical changes in preparation practice were known to have been made, it was considered necessary to select, for sampling, such banks as contained cuts, washouts or other exposed cross sections and to make separate composite samples of distinctly different portions of the bank.

To check the screening tests and ascertain whether or not samples of sufficient size were being used, tests were made on two sets of duplicate samples of Ontario bank coal. These duplicate samples were each cut out separately by quartering down the entire composite sample. One such test was made on the composite surface sample of section 2, the north wing of the bank; and one of section 3, the south wing of the bank. Results of these duplicate screen tests are

given in tables 12 and 13. The maximum variation from the mean was 1.2 per cent in the size between 3/64 and 3/32 inches in the samples of section 3 and the average variation from the mean was 0.25 per cent.

Table 12. Screen analyses of duplicate samples from north wing of Ontario breaker bank.

Size		First sample		Second sample		Mean
Through	Over	Weight, grams	Per cent of total	Weight, grams	Per cent of total	Per cent of total
	5/16"	5	.4	3	.2	0.3
5/16"	3/16"	5	.4	5	.4	0.4
3/16"	3/32"	36	2.9	34	2.7	2.8
3/32"	3/64"	297	24.1	307	24.3	24.2
3/64"	50	524	42.6	549	43.3	42.9
50	100	224	18.2	230	18.2	18.2
100	200	83	6.8	74	6.3	6.6
200	----	57	4.6	60	4.6	4.6
Total ---	----	1,231	100.0	1,267	100.0	100.0

Table 13. Screen analyses of duplicate samples from south wing.

Size		First sample		Second sample		Mean
Through	Over	Weight, grams	Per cent of total	Weight, grams	Per cent of total	Per cent of total
	5/16"	3	0.2	3	.3	.25
5/16"	3/16"	7	0.5	4	.4	.45
3/16"	3/32"	46	3.5	26	3.0	3.25
3/32"	3/64"	387	29.5	239	27.1	28.3
3/64"	50	562	42.8	379	43.0	42.9
50	100	216	16.5	159	18.0	17.25
100	200	55	4.2	44	5.0	4.6
200	----	37	2.8	28	3.2	3.0
Total, ---	----	1,313	100.0	882	100.0	100.0

Sampling and Measurement of Waste Water

Water sampling. To estimate the rate of silt production in tons per day and the losses of fine coal in breaker water, slush bank run-off water, and any other waste water discharged from the preparation plant, it was necessary at practically every colliery to collect representative samples of such waste water products with a proportionate sample of the solids carried in suspension.

Where the stream of water to be sampled is so small that a sample can be caught in an open pail without splash or overflow, this is a satisfactory method of sampling and it was used at some of the smaller plants. However, this method was impracticable in most cases because of the size and swiftness of the stream which made it impossible to catch a sample without some of the water splashing out

of or overflowing the pail, leaving a portion of its solids therein and thus making the sample not representative as to percentage of solids.

For sampling large and swift flowing streams a special sampling dipper was constructed as shown in Figure 20. This is a triangular prismatic box with a wide bottom (8 by 10 in.) and drawn in to a width 5/8 inch at the top, which is open to receive the sample. One of the triangular ends bears a shank to receive a round handle. To sample a stream of water with this device, a place where the water falls a sufficient height for the dipper to be placed in the descending stream is selected; or a fall is made for this purpose. A

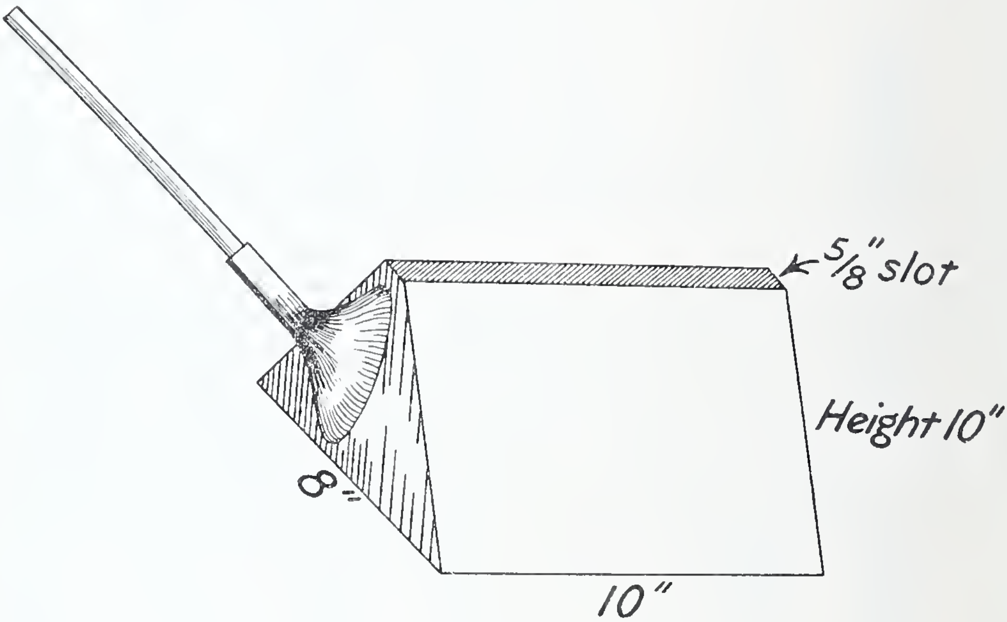


FIGURE 20

Water sampling dipper.

suitable handle is inserted in the shank, and the sampler is moved uniformly across the stream so as to receive a representative increment of the entire cross section of the stream in the narrow opening of the box. By this method a small sample can be taken from a large swift stream without splash or overflow.

Individual samples were collected in this manner at regular intervals (usually half-hourly) until a 20 gallon sample was obtained. This composite sample was accumulated in an iron tub. It was then settled overnight and as much of the water decanted as possible without loss of solids. The sample was then evaporated to dryness over a fire, or steam pipes, and the residue weighed to ascertain the proportion of solids carried by the water. Samples were also retained for sizing tests and chemical analyses.

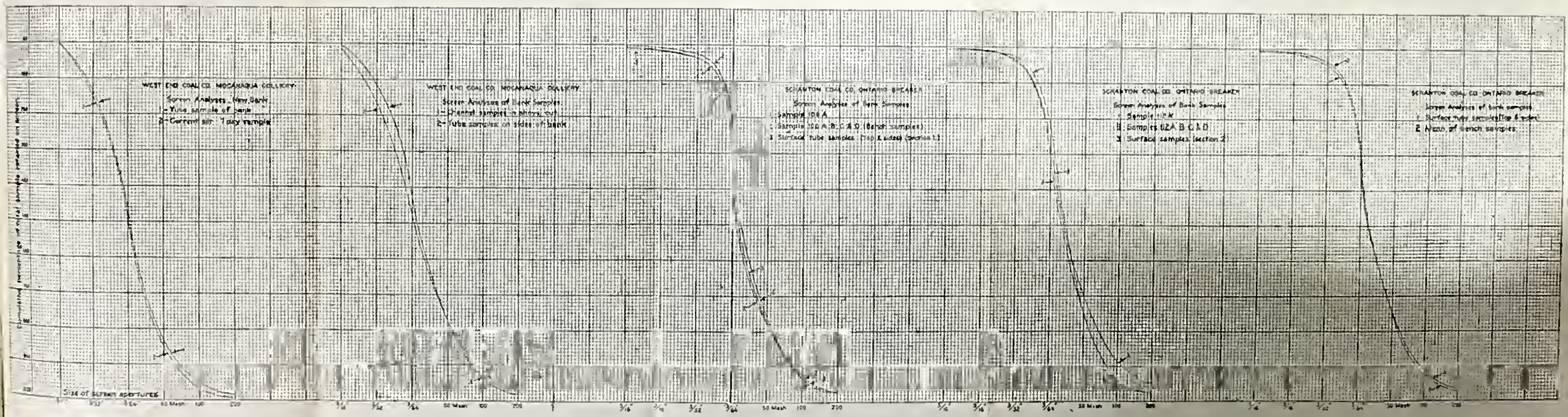


FIGURE 21

Graphs of screen analyses of bank samples at Mocanaqua Colliery of the West End Coal Co., Mocanaqua, and at Ontario Colliery of the Scranton Coal Co. at Peckville.

Measurement of rate of flow. To estimate the total quantity of fine coal carried away by the water or flushed out upon the silt bank in a stream of water, it is necessary to measure the rate of flow as well as the proportion of solids in the water. In a few cases, wide-crest wiers were found in the normal course of the stream, as an incident of tank or flume construction; in one other case, a sharp-crest wier was constructed especially for the work; and in a few cases small streams were measured by catching the entire discharge and measuring the time required to fill a large tub. Except where such special facilities were available, however, the rate of flow was estimated by the approximate method* of measuring the time required for floats to traverse a measured course. For this purpose a straight 100-foot section of uniform slope was marked off along the flume or other watercourse, and small wooden floats were thrown into the stream above the upper end of this 100-foot course and the time required for the float to pass over the course was measured with a stop watch. The length of the course, divided by the time interval in seconds, gives the velocity of flow in feet per second, at the center of the surface of the stream. To reduce this to average velocity over the entire cross-section of the stream it is necessary to use a factor to compensate for the lag of those sections of the stream adjacent to the sides and bottom. The factor used in these computations was .80. (See Merriam, op. cit., p. 120). This reduces surface velocity to mean velocity.

The mean velocity measured in this way (.80xfloat velocity) multiplied by the cross-section area of the stream in square inches and divided by 231 (cubic inches per gallon) gives the rate of flow in gallons per second. With this measurement and the weight of solids per gallon of water determined by sampling, the rate of flow of coal in tons per day may be calculated.

SUSQUEHANNA COLLIERIES COMPANY

Short Mountain Colliery

The output of this colliery is 1,200 to 1,500 tons of prepared coal a day. It is prepared over James and Menzies jigs. A washery which operates intermittently on bank coal was also working at the time of sampling. Silt passes through a screen which has some 1/16-inch and some 3/32-inch perforations. The silt and water go to a small sump from which it is pumped up onto a storage bank. A part of the water and slime overflow this sump. It joins with other waste water from the breaker and the washery, and with some from hydraulicing operations on a culm and silt bank that is being used for boiler plant fuel. This water flows away to the river. It was sampled at half-hourly intervals and measured by timing floats in the combined stream. The rate of water flow was 2,420 gallons per minute and it carried away 186 tons of fine-sized solids per day. This material is practically all finer than the usual steam sizes but it is comparatively low in ash.

An old silt bank which was started about 1885 originally contained 1,000,000 tons of silt of exceptionally low ash content. Part of it

* Elements of hydraulics, Merriman Mansfield, John Wiley & Sons, p. 120.

has been briquetted by the American Briquet Company and part of it is held in reserve for future use in the dust-burning boiler plant operated by the Susquehanna Collieries Company. The part of the bank intended for boiler plant fuel was sampled with the 10-foot sampling tube. It contains 9.4 per cent of No. 2 buckwheat and 13.8 per cent of No. 3 buckwheat coal.

Analysis of sample of silt bank at Short Mountain Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	64	2.4	39.4	.60	8.1	52.5	8,800
3/16″	3/32″	367	13.8	28.0	.50	8.2	63.8	10,780
3/32″	3/64″	655	24.3	21.0	.60	10.1	68.9	11,910
3/64″	50 mesh	910	34.1	17.3	.60	10.7	72.0	12,530
50 mesh	100 mesh	332	12.5	19.6	.50	9.1	71.3	12,130
100 mesh	200 mesh	156	5.8	16.6	.70	9.4	74.0	12,580
200 mesh	----------	183	6.9	18.2	.60	8.9	72.9	12,310
Total		2,667	100.0	----------	----------	----------	----------	----------
Average		----------	----------	20.5	.58	9.7	67.7	11,885

Analysis of solids in waste water from breaker bank and washery at Short Mountain Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	50 mesh	18	3.8	13.7	7.0	18.2	.60	8.9	72.9	12,310
50 mesh	100 mesh	103	21.5	77.4	40.0	20.7	.60	11.2	68.1	11,360
100 mesh	200 mesh	63	13.2	47.5	24.6	8.7	.70	12.8	78.5	13,190
200 mesh	----------	294	61.5	221.4	114.4	22.8	.70	11.9	65.3	10,940
Total		478	100.0	360.0	186.0	-------	-------	-------	-------	-------
Average		-------	-------	-------	-------	20.3	.67	11.8	67.9	11,379

Rate of water flow 2420 gal. per minute.

PINE HILL COAL COMPANY

Pine Hill Colliery

This plant prepares 1,200 to 1,500 tons of coal a day. The silt is screened through 3/32-inch perforations and goes by flume to a series of three large settling basins. These basins are in a small valley between the Pine Hill and Oak Hill collieries. The three basins constitute one continuous bank but they are separated by silt embankments. The water spreads out over the first bank and deposits part of its silt load; then it overflows into the second bank where a further clarification takes place, and then it flows into the third bank. A marked classifying and cleaning effect is obtained by this treatment. The first two basins were sampled separately by 10-

foot holes over the surface. Screen analyses of the two samples are given in the accompanying tables, and show that a large proportion of the fines is carried over into the second basin plus the lower ash part of the coarse material. The average ash content of silt in the first basin is 35.4 per cent and in the second basin 22.7 per cent.

An old bank in addition to these basins and continuous with them appears to contain some buckwheat coal and slate. It was sampled separately. Screen analysis showed it to contain considerable proportions of No. 1, No. 2, and No. 3 buckwheat but these sizes are high in ash.

Analysis of old part of silt bank, Pine Hill Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	92	4.4	47.7	.50	7.2	45.1	7,170
3/16″	3/32″	107	5.2	39.5	.80	8.0	52.5	8,550
3/32″	3/64″	348	16.7	33.4	.80	5.9	60.7	9,570
3/64″	50 mesh	750	36.1	35.6	.80	4.8	59.6	9,220
50 mesh	100 mesh	422	20.3	42.3	.80	7.0	50.7	8,160
100 mesh	200 mesh	170	8.2	42.8	.90	6.6	50.6	7,900
200 mesh	------------	190	9.1	53.6	.70	7.5	38.9	6,190
Total		2,079	100.0					
Average				39.6	.79	6.1	54.3	8,560

Analysis of first bank that receives silt direct from breaker at Pine Hill Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	12	.9	29.0	.90	7.2	63.8	10,410
3/16″	3/32″	135	10.2					
3/32″	3/64″	308	23.2	31.1	.80	5.9	63.0	9,960
3/64″	50 mesh	480	36.2	30.7	.80	7.6	61.7	10,020
50 mesh	100 mesh	216	16.3	41.6	.70	6.5	51.9	8,220
100 mesh	200 mesh	65	4.9	50.1	.50	6.9	43.0	6,720
200 mesh	------------	110	8.3	55.2	1.20	8.7	36.1	6,100
Total		1326	100.0					
Average				35.4	.81	7.0	57.6	9,269

Analysis of second bank at Pine Hill Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	164	7.6	17.5	.60	5.8	76.7	12,160
3/32″	3/64″	590	27.5	13.8	.60	4.5	81.7	12,750
3/64″	50 mesh	624	29.0	15.6	.60	5.2	79.2	12,490
50 mesh	100 mesh	327	15.2	22.1	.60	5.2	72.7	11,420
100 mesh	200 mesh	152	7.1	36.1	.50	5.6	58.3	9,170
200 mesh	------------	292	13.6	52.5	.70	7.2	40.3	6,420
Total		2149	100.0					
Average				22.7	.61	5.4	71.9	11,312

ST. CLAIR COAL COMPANY

St. Clair Colliery

This plant prepares about 1,200 tons of coal a day by the Chance sand flotating process. Barley coal and silt go into the separators with the commercial sizes of coal and are subsequently separated from the sand by screens and hydroseparators. Silt is made through a 3/32-inch round-hole screen. The silt is settled in two cylindrical steel tanks that are used alternately; the silt and water are discharged into one while the silt that has previously accumulated in the other is loaded out by a grab bucket operated from an overhead traveling crane. This dewatered silt is used in the briquet plant. The production is about 40 tons a day. The water and silt that overflows these banks is collected in a catchbasin and is elevated to the silt bank by centrifugal pumps. Some water overflows this basin and carries fine silt into Mill Creek.

The silt bank upon which the current silt production from the pumps is stored is on top of a rock bank. The water drains away into and through the rock bank. The silt is completely retained on the bank. Two old silt banks, mixed with culm, were sampled separately with the 10-foot sampling tube. The total tonnage in these two banks is 1,000,000. About 200,000 tons of this is No. 3 buckwheat.

The loss of silt in the pump basin overflow was measured by sampling the water at half-hour intervals during a day's operation and by measuring the rate of flow at the wier-shaped spillway.

Analysis of north bank, St. Clair Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	28	1.8 }	24.4	.50	5.9	69.7	10,940
3/16″	3/32″	202	12.9 }					
3/32″	3/64″	510	32.7	23.6	.50	5.6	70.8	11,030
3/64″	50 mesh	530	33.9	29.6	.40	6.2	64.3	10,100
50 mesh	100 mesh	190	12.2	38.4	.40	6.0	55.6	8,710
100 mesh	200 mesh	36	2.3	44.0	.30	6.4	49.6	7,810
200 mesh	------------	66	4.2	52.9	.60	9.2	37.9	6,090
Total		1562	100.0	------	------	------	------	------
Average		------	------	29.2	.45	6.1	64.7	10,137

Analysis of south bank, St. Clair Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	435	24.0	28.2	.50	5.6	66.2	10,370
3/32″	3/64″	600	33.1	24.9	.50	4.8	70.3	10,920
3/64″	50 mesh	555	30.6	23.2	.50	4.3	72.5	11,100
50 mesh	100 mesh	136	7.5	44.8	.50	5.8	49.4	7,810
100 mesh	200 mesh	30	1.6	46.5	.50	6.9	46.6	7,440
200 mesh	------------	58	3.2	54.6	.60	8.2	37.2	5,830
Total		1814	100.0	------	------	------	------	------
Average		------	------	28.0	.51	5.0	67.0	10,391

Analysis of current silt (dewatered in settling tank), St. Clair Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	90	4.3	25.4	.50	6.0	68.6	11,020
3/32″	3/64″	572	27.0	19.6	.60	6.2	74.2	11,840
3/64″	50 mesh	924	43.7	24.0	.50	6.2	69.8	11,140
50 mesh	100 mesh	343	16.2	45.2	.30	5.6	49.2	7,730
100 mesh	200 mesh	100	4.7	46.2	.40	7.0	46.8	7,310
200 mesh	------------	86	4.1	47.3	.40	8.6	44.1	6,969
Total		2115	100.0					
Average				28.3	.49	6.2	65.5	10,470

FRACKVILLE COAL MINING COMPANY

Lucanna Colliery

This is a new operation, which has not developed to normal operating tonnage. The breaker operates intermittently, and prepared, at the time of sampling, 150 tons of coal a day. The silt passes through a 1/16-inch round-hole screen. It is flumed out upon a small bank, from which the water runs off to Schuylkill River. There is no embankment around this accumulation and much of it washes into the stream.

The current silt production was sampled at half-hour intervals and measured by timing floats in the flumes that carries it to the bank. The bank was not sampled. It is of recent accumulation and is well represented by the sample of current silt. This sample contained 18 per cent barley coal. Assuming this to be representative of the bank, it is estimated to contain 240 tons of barley coal and 4,200 tons of No. 2 barley.

The rate of silt production was 12 tons per hour during actual operation, or 96 tons per day if the plant were operated continuously when the samples were collected. The breaker was actually operating only about one-third of the time, which would make the daily production of silt 32 tons.

Analysis of current silt production, Lucanna Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal	Tons per 8 hr. day	Ash	Sul-phur	Vola-tile matter	Fixed carbon	
------	3/32″	26	1.8	32.4	1.7	40.5	.60	7.0	52.6	8,410
3/32″	3/64″	306	21.6	388.8	20.7					
3/64″	50 mesh	550	38.7	696.6	37.2	40.9	.60	7.9	51.2	8,280
50 mesh	100 mesh	270	19.0	342.0	18.3	44.2	.50	7.8	48.0	7,740
100 mesh	200 mesh	108	7.6	136.8	7.3	47.8	.60	7.9	44.3	7,230
200 mesh	------------	160	11.3	203.4	10.8	52.4	.40	10.5	37.1	6,210
Total		1420	100.0	1800.0	96.0					
Average						43.2	.56	8.0	48.8	7,894

*Assuming steady operation of breaker. At time of sampling breaker operated about one-third of time.

HAZEL BROOK COAL COMPANY

Mary D Colliery

The silt at this plant is screened through 1/16-inch perforations. It is dewatered in a small settling basin with a perforated bucket elevator that delivers it to an inclined drag conveyor. At the time of sampling the dewatered and deslimed silt was being loaded into railway cars for shipment. When it is not shipped it is stocked on a bank which at the time of sampling contained about 50,000 tons. The effluent water from the settling tank carries about 20 tons of fine silt into Schuylkill River each day.

The silt production varies from day to day but averages about 200 tons daily of dewatered shipped silt. The following table of shipments for several days at the time of sampling show the ratio of silt to prepared sizes:

Prepared coal, tons	Silt shipped, tons
791	150
816	200
715	200
737	200
813	213

Analysis of silt bank, Mary D Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	54	2.9	29.2	.60	7.0	63.8	10,310
3/16"	3/32"	87	4.7	26.5	.60	4.4	69.1	10,670
3/32"	3/64"	464	25.0	24.6	.50	3.9	71.5	10,970
3/64"	50 mesh	732	39.4	24.7	.50	4.3	71.0	10,950
50 mesh	100 mesh	353	19.0	28.4	.50	3.9	67.7	10,400
100 mesh	200 mesh	103	5.6	32.7	.50	3.8	63.5	9,840
200 mesh	------------	64	3.4	36.2	.60	5.5	58.3	9,160
Total		1857	100.0	----------	----------	----------	----------	----------
Average		----------	----------	26.4	.51	4.2	69.4	10,696

Analysis of solids in settling tank effluent water, Mary D Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	50 mesh	11	2.8	8.2	--------	19.3	.80	5.8	74.9	11,870
50 mesh	100 mesh	96	24.7	72.5	--------					
100 mesh	200 mesh	62	15.9	46.7	--------	21.9	.80	4.8	73.3	11,490
200 mesh	------------	220	56.6	166.1	--------	37.3	.80	7.8	54.9	8,770
Total		389	100.0	293.5		--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	29.9	.80	6.8	63.3	10,055

Analysis of current silt production (dewatered), Mary D Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	47	2.2	----------	4.4	17.9	.70	8.1	74.0	12,240
3/32"	3/64"	435	20.2	----------	40.4	21.2	.90	5.2	73.6	11,620
3/64"	50 mesh	1200	55.8	----------	111.6	19.5	.90	4.1	76.4	11,900
50 mesh	100 mesh	360	16.8	----------	33.6	28.6	.90	4.9	66.5	10,400
100 mesh	200 mesh	60	2.8	----------	5.6	43.2	1.80	7.4	49.4	8,130
200 emhs	----------	47	2.2	----------	4.4	35.9	1.20	7.0	57.1	9,030
Total		2149	100.0	----------	200.0	------	------	------	------	------
Average		------	------	----------	------	22.4	.93	4.7	72.9	11,430

*Average daily shipments.

LEHIGH COAL AND NAVIGATION COMPANY

Coaldale Colliery

This plant handles about 1,600 three-ton cars of mine-run coal a day and prepares 2,500 to 3,000 tons of marketable coal. This is prepared over Wilmot jigs, Deister-Overstrom tables, and Dorr classifiers. A mixture of No. 4 buckwheat coal and silt dewatered in a settling tank is sometimes shipped to the briquetting plant of Navicoal Corporation at Perth Amboy, N. J. This product is washed on Deister-Overstrom tables. When it is not shipped it is pumped up into a large silt basin on top of a rock bank. The water drains away into and through the rock bank and apparently carries no silt into the stream.

The overflow water and fine silt, which is estimated at 600 gallons per minute, is discharged into Panther Creek. This water carries .238 pounds of solids to the gallon, which amounts to 30 tons per day. The loss of marketable coal at this point is negligible, as only 0.6 per cent of it is retained on a 3/64-inch screen. The daily production of dewatered and deslimed silt suitable for shipment is 300 to 340 tons.

The silt bank, upon which the silt was being stored at the time of investigation, was sampled with the 10-foot tube. Holes were placed over the surface on 200-foot centers. The material in this bank is 3.7 per cent No. 3 buckwheat and 23.9 per cent No. 4 buckwheat size.

Analysis of silt bank sample, Coaldale Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	63	3.7	30.8	.60	6.3	62.9	9,890
3/32"	3/64"	409	23.9	29.6	.60	4.7	65.7	10,180
3/64"	50 mesh	645	37.7	27.6	.60	4.8	67.6	10,430
50 mesh	100 mesh	340	20.0	32.2	.70	5.5	62.3	9,630
100 mesh	200 mesh	124	7.3	35.8	.50	6.0	58.5	8,990
200 mesh	----------	126	7.4	38.8	.40	7.5	53.7	8,390
Total		1707	100.0	------	------	------	------	------
Average		------	------	30.5	.59	5.3	64.2	9,937

Analysis of silt bank sample, Coaldale Colliery, cont'd.

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	36.7	4.2	35.6	18.4	27.7	76.0	72.3	11.2
3/64"	50 mesh	46.0	4.0	34.5	19.3	19.5	72.5	80.5	10.6

Analysis of solids in effluent water from settling tank, Coaldale Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64"	6	.6	1.4	-------					
3/64"	50 mesh	50	5.0	11.9	-------	22.7	1.20	7.2	70.1	10,990
50 mesh	100 mesh	240	24.1	57.4	--------	21.8	.90	7.3	70.9	11,210
100 mesh	200 mesh	151	15.1	35.9	--------	26.4	.70	5.3	68.3	10,540
200 mesh	------------	550	55.2	131.4	--------	41.3	.90	8.4	50.3	7,890
Total		997	100.0	238.0	--------	--------	--------	--------	--------	----------
Average		--------	--------	----------	--------	33.3	.89	7.6	59.1	9,264

LEHIGH COAL AND NAVIGATION COMPANY

Tamaqua Colliery

This colliery produces about 1,200 tons of marketable coal a day. The smallest size of screened coal produced is No. 4 buckwheat made over a 1/32-inch screen. The silt that passes through this screen goes to a settling tank. The dewatered and deslimed silt is picked up by a perforated bucket elevator and stacked by an inclined scraper line or loaded into railway cars for shipment. The silt was being shipped at the time of sampling. The rate of silt production ranges from 2 to 5 cars a day. The effluent water from this settling tank and some other waste waters from the breaker, discharge into a marsh which is filled with silt to a depth of 2 to 10 feet. This deposit is not banked up in any way and is skirted along side by a small stream that washes some of the silt into Panther Creek. Slush water from the jigs and drainage from the rock pockets goes directly to this stream through a vitrified tile launder. The water and solids carried by this flume were sampled and measured by timing floats in the stream. The silt tank overflow water was sampled but not

measured. The jig slush flume carries an average of 685 gallons per minute and discharges 216 tons of solid per day. This is practically all too fine for commercial use and is also high in ash content; 65.4 per cent of it passes through a 100-mesh screen and only .9 per cent is retained on a 3/64-inch round hole screen.

Both the silt stock pile and the swamp deposit in the creek valley were sampled with the 10-foot sampling tube. The silt bank contains 10,000 tons of barley coal of 28.6 per cent ash content and 128,000 tons of No. 2 barley of 29.0 per cent ash content. The flat deposit in the valley contains 22,000 tons of barley size and 46,000 tons of No. 2 barley size but the material is much higher in ash than that stocked in the bank.

Analysis of solids in water discharged from jigs, Tamaqua Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64"	6	.9	.9	.2					
3/64"	50 mesh	80	12.0	12.5	2.6	26.9	.80	6.4	66.7	10,400
50 mesh	100 mesh	145	21.7	22.6	4.7	20.7	.70	6.4	72.9	11,600
100 mesh	200 mesh	112	16.8	17.5	3.6	27.3	.60	4.9	67.8	10,500
200 mesh	------------	325	48.6	50.5	10.5	40.9	.70	7.2	51.9	8,090
Total		668	100.0	104.	21.6	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	32.4	.70	6.6	61.0	9,554

Analysis of sample from bank receiving dewatered silt from settling tank, Tamaqua Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	44	2.4	28.6	1.10	8.6	62.8	10,320
3/32"	3/64"	580	31.8	29.0	.80	5.3	65.7	10,310
3/64"	50 mesh	850	46.5	25.8	.80	6.6	67.6	10,810
50 mesh	100 mesh	240	13.1	32.3	.90	7.9	59.8	9,890
100 mesh	200 mesh	49	2.7	38.6	1.00	6.3	55.1	8,750
200 mesh	------------	63	3.5	40.0	1.20	7.4	52.6	8,220
Total		1826	100.0	--------	--------	--------	--------	--------
Average		--------	--------	28.6	.94	6.4	65.0	10,372

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	6.9	2.3	64.4	11.8	28.7	77.0	71.3	10.9
3/64″	50 mesh	4.0	2.0	66.7	12.3	29.3	54.5	70.7	11.7

Analysis of sample from silt basin receiving settling tank overflow water, Tamaqua Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	245	11.3	41.0	.40	5.8	53.2	8,380
3/32″	3/64″	509	23.5	30.3	.80	6.6	63.1	10,110
3/64″	50 mesh	810	37.5	33.2	.70	5.7	61.1	9,630
50 mesh	100 mesh	400	18.5	41.7	.80	4.6	53.7	8,220
100 mesh	200 mesh	104	4.8	41.8	.60	5.0	53.2	8,060
200 mesh	----------	94	4.4	42.0	.50	6.2	51.8	8,010
Total		2162	100.0					
Average		----------	----------	35.7	.69	5.7	58.6	9,196

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	29.3	4.0	37.9	16.4	32.8	78.5	67.2	11.0
3/64″	50 mesh	22.9	3.7	40.6	17.0	36.5	79.3	63.5	12.2

Analysis of solids in effluent water from silt dewatering tank, Tamaqua Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64″	23	2.5	16.9	--------					
3/64″	50 mesh	180	19.6	132.7	--------	21.5	.90	6.6	71.9	11,410
50 mesh	100 mesh	276	29.9	202.4	--------	20.2	.90	6.8	73.0	11,690
100 mesh	200 mesh	160	17.3	117.1	--------	25.1	.70	4.6	70.3	10,850
200 mesh	----------	283	30.7	207.9	--------	34.7	.70	7.2	58.1	9,090
Total,		922	100.0	677.0	--------					
Average		----------	----------	----------	--------	25.8	.80	6.5	67.7	10,184

LEHIGH COAL AND NAVIGATION COMPANY

Nesquehoning Colliery

This plant prepares 3,000 tons of coal a day over Wilmot jigs and Deister-Overstrom tables. The silt is screened through 1/16 inch holes. The water and silt from the screens and washers goes by tile flume to two centrifugal pumps that lift it up to an extensive silt deposit on top of a rock bank; 300 to 400 gallons per minute overflow this flume into Nesquehoning Creek. The water pumped onto the bank with the silt drains out through the rock bank and joins the creek. It carries very little silt. Small streams trickle out of the base of the rock bank at various points along the creek which skirts the bank. Some of these streamlets are clear and some slightly discolored.

The water that drains from the lip screens and loaded cars carries some silt into the creek. This was sampled and measured by catching the entire stream for a measured time. The rate of flow varied greatly but averaged about 250 gallons per minute. The proportion of solids was 112 pounds per thousand gallons. This amounts to 4 to 5 tons per day.

The current silt production was sampled at half-hourly intervals throughout a day's operation and measured by timing floats in the flume that carries the water and silt to the pumps. The rate of water flow was 2,600 gallons per minute and the quantity of silt carried was 408 tons a day.

The bank was sampled with the 10 foot tube. When this bank was started the finest screens in use had 1/8 inch perforation and some coal even larger than this was stocked on the bank when it had no sale. The section of this bank which was not covered with new material was sampled separately. This part of the bank contains 4.3 per cent of No. 2 buckwheat and 11.7 per cent of No. 3 buckwheat. The upper part of the bank contains practically no No. 2 buckwheat but has 10.1 per cent of No. 3 buckwheat coal. The bank contains 1,200,000 tons; of this, probably 25,000 tons is No. 2 buckwheat and 125,000 tons is No. 3 buckwheat.

Analysis of sample from lower old part of silt bank, Nesquehoning Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	74	4.3	35.1	.60	6.4	58.5	9,560
3/16″	3/32″	200	11.7	29.6	.50	4.7	65.7	10,160
3/32″	3/64″	463	27.1	32.4	.60	4.0	63.6	9,860
3/64″	50 mesh	544	31.9	35.1	.50	4.0	60.9	9,400
50 mesh	100 mesh	264	15.4	38.3	.60	4.3	57.4	8,920
100 mesh	200 mesh	86	5.0	37.1	.70	5.2	57.7	9,030
200 mesh	----------	77	4.5	41.2	.50	6.8	52.0	8,200
Total		1708	100.0					
Average		----------	----------	34.6	.56	4.4	61.0	9,465

Analysis of sample from upper, new part of silt bank, Nesquehoning Colliery.

Size: Through	Size: Over	Screen analysis: Grams	Screen analysis: Per cent of total	Chemical analysis: Ash	Chemical analysis: Sulphur	Chemical analysis: Volatile matter	Chemical analysis: Fixed carbon	B. t. u. per pound
------	3/32″	167	10.1	38.7	.40	5.4	55.9	8,790
3/32″	3/64″	430	26.1	33.3	.50	5.0	61.7	9,570
3/64″	50 mesh	618	37.5	36.4	.50	4.8	58.8	9,120
50 mesh	100 mesh	286	17.4	43.2	.40	4.9	51.9	7,990
100 mesh	200 mesh	83	5.0	46.3	.70	5.8	46.3	7,390
200 mesh	------------	65	3.9	48.6	.70	6.7	44.7	7,010
Total		1,649	100.0					
Average				38.0	.49	5.1	56.9	8,839

Analysis of current silt production, Nesquehoning Colliery.

Size: Through	Size: Over	Screen analysis: Grams	Screen analysis: Per cent of total	Quantity of solids: Pounds per 1,000 gal.	Quantity of solids: Tons per 8 hr. day	Chemical analysis: Ash	Chemical analysis: Sulphur	Chemical analysis: Volatile matter	Chemical analysis: Fixed carbon	B. t. u. per pound
------	3/32″	40	2.7	19.5	11.0	20.7	1.00	9.0	70.3	11,710
3/32″	3/64″	214	14.5	105.0	59.2	25.8	.60	4.3	69.9	10,800
3/64″	50 mesh	397	26.9	194.8	109.8	29.6	.60	4.9	65.5	10,160
50 mesh	100 mesh	262	17.8	128.9	72.6	29.8	.70	5.0	65.2	10,160
100 mesh	200 mesh	135	9.2	66.6	37.5	31.3	.60	5.0	63.7	9,840
200 mesh	------------	425	28.9	209.2	117.9	47.1	.50	6.9	46.0	7,250
Total		1,473	100.0	724.	408.					
Average						34.1	.60	5.5	60.4	9,425

Current silt production.

Size: Through	Size: Over	Lighter than 1.6: Per cent of total	Lighter than 1.6: Ash	1.6 to 1.9: Per cent of total	1.6 to 1.9: Ash	Heavier than 1.9: Per cent of total	Heavier than 1.9: Ash	Combined float on 1.9: Per cent of total	Combined float on 1.9: Ash
3/32″	3/64″	55.2	5.5	23.2	23.5	21.6	78.5	78.4	10.8
3/64″	50 mesh	45.7	5.7	25.0	24.6	29.3	73.0	70.7	12.4

SOUTH PENN COLLIERIES COMPANY

Kathryn Colliery

The production of this colliery is about 600 tons a day. The silt passes through a 1/16-inch screen. It is flushed out upon a small bank between the highway and Zerbe Run. The silt is impounded on the bank by silt embankments that are kept built up above the

surface of the bank. Over flow water and slime is discharged into Zerbe Run. The daily production of silt is about 80 to 100 tons. The bank is washed by Zerbe Run and some of the silt is carried away in high water seasons. There is an accumulation of 2 to 6 feet of silt in the bed and on the flood plain of the creek.

Water from the lip screens and loaded cars, amounting to about 150 gallons per minute, is discharged directly into Zerbe Run. This water carries 40 pounds of solids per 1,000 gallons. The bank contains 1,500 tons of barley coal of 19.7 per cent ash content.

Analysis of silt bank sample, Kathryn Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	16	.5	19.7	.70	11.8	68.5	12,200
3/16″	3/32″	137	3.8					
3/32″	3/64″	644	18.1	21.9	.70	10.5	67.6	11,820
3/64″	50 mesh	1324	37.2	20.4	2.00	10.2	69.4	12,070
50 mesh	100 mesh	844	23.7	18.5	.70	10.4	71.1	12,410
100 mesh	200 mesh	300	8.4	20.3	.60	11.7	68.0	12,160
200 mesh	----------	296	8.3	24.0	.60	10.8	65.2	11,490
Total		3561	100.0					
Average				20.5	1.17	10.5	69.0	12,070

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/64″	50 mesh	75.8	8.0	12.1	38.6	12.1	72.6	87.9	12.2
50 mesh	100 mesh	77.2	8.4	11.4	38.5	11.4	71.0	88.6	12.3

SUSQUEHANNA COLLIERIES COMPANY

Luke Fidler Colliery

This colliery prepares about 1,600 tons of coal a day. The silt is screened through 1/16-inch perforations and is conveyed to the bank in a stream of water. The water spreads out over the bank, deposits the coarser part of the silt and runs off by wooden sluiceway to the creek. It carries away a large proportion of the silt, including 3.0 per cent of barley coal. The breaker water supply is pumped from a small basin that receives the mine water and the drainage from the lip screens and loaded cars. A small quantity of water continually overflows the spillway of this catch basin but it carries very little silt. However, at the end of each shift, flood

gates in the dam are opened and the silt that has accumulated in the pool is flushed out into the creek.

The silt bank that was being used for stocking current silt production, was sampled with 10-foot holes spaced on 100-foot centers. It contains 6.6 per cent of barley coal size which is approximately half good coal.

Analysis of solids in run-off water from silt bank, Luke Fidler Colliery.

Size		Screen analysis		of solids Quantity		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	82	3.0	16.5	--------	23.0	1.10	8.5	68.5	11,420
3/32"	3/64"	492	18.2	100.5	--------	22.3	1.00	6.9	70.8	11,580
3/64"	50 mesh	900	33.2	183.3	--------	23.1	1.00	6.8	70.1	11,470
50 mesh	100 mesh	594	21.9	120.9	--------	26.4	1.20	7.2	66.4	10,880
100 mesh	200 mesh	180	6.7	37.0	--------	28.6	1.50	7.7	63.7	10,550
200 mesh	----------	460	17.0	93.8	--------	36.5	1.00	8.1	55.4	9,120
Total		2708	100.0	552.0	--------	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	26.3	1.08	7.4	66.4	10,898

Analysis of silt bank sample, Luke Fidler Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	200	6.6	52.6	.70	8.5	38.9	6,520
3/32"	3/64"	900	29.7	49.3	.70	8.5	42.2	7,030
3/64"	50 mesh	1170	38.6	45.5	1.50	7.8	46.7	7,610
50 mesh	100 mesh	508	16.8	47.3	2.20	7.5	45.2	7,270
100 mesh	200 mesh	140	4.6	45.1	1.60	9.1	45.8	7,670
200 mesh	----------	114	3.7	41.2	2.80	9.3	49.5	8,150
Total		3032	100.0	--------	--------	--------	--------	--------
Average		--------	--------	47.2	1.38	8.1	44.7	7,331

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	25.4	9.2	21.3	25.0	53.3	77.6	46.7	16.4
3/64"	50 mesh	37.3	8.7	13.7	32.8	49.0	78.5	51.0	15.2

LEHIGH VALLEY COAL COMPANY

Sayre Colliery

The daily production of this plant is about 1,400 tons. It is part fresh-mined and part bank coal. It is prepared by Lehigh Valley and Simplex jigs and shaker screens. The silt is screened through 1/16-inch round holes. The silt and water now flows to a 90-foot Dorr thickener, from which the thickened silt is elevated by inclined scraper conveyor to the silt bank and the clarified water that overflows the thickener goes to the breaker water supply sump or to the creek. Prior to the installation of the thickener in May, 1924, the silt was dewatered in a small settling tank and elevated to a large conical bank. At that time the silt was made through a 3/32-inch screen.

The thickener receives 1,560 gallons of water and silt per minute. The overflow water contains an average of .048 pounds of solids per gallon, or 16 tons a day. This material is practically all dust; 93.2 per cent will pass through a 200-mesh screen. The underflow contains 9.6 per cent through 200 mesh. The rate of silt production is 200 to 250 tons a day. It contains only 0.3 per cent barley coal.

The new silt bank, which is now being used for storing the silt dewatered by the Dorr thickener, was sampled by the surface sampling method by using a 10-foot tube. This bank contains only 0.4 per cent of barley coal retained on a 3/32-inch screen.

Analysis of current silt production, Sayre Colliery

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	6	.3					
3/32″	3/64″	572	21.4	21.8	1.00	6.2	72.0	11,510
3/64″	50 mesh	946	35.3	24.3	1.10	7.3	68.4	11,120
50 mesh	100 mesh	630	23.5	27.2	1.20	7.7	65.1	10,640
100 mesh	200 mesh	266	9.9	34.0	1.10	7.6	58.4	9,440
200 mesh	------------	258	9.6	48.1	.50	7.9	44.0	6,970
Total		2678	100.0					
Average				27.7	1.04	7.2	65.1	10,527

Analysis of solids in effluent water from 90-foot Dorr thickener, Sayre Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sul-phur	Vola-tile matter	Fixed carbon	
------	50 mesh	8	4.2	2.0	.6					
50 mesh	100 mesh	3	1.6	.8	.3	49.1	.80	9.4	41.5	6,680
100 mesh	200 mesh	2	1.0	.5	.2					
200 mesh	------------	177	93.2	45.2	14.9					
Total		190	100.0	48.5	16.0					
Average						49.1	.80	9.4	41.5	6,680

Rate of water flow 1560 gallons per minute.
Screened products not analyzed.

Analysis of silt bank samples, Sayre Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	8	.4					
3/32"	3/64"	284	15.8	29.6	1.00	10.2	60.2	10,130
3/64"	50 mesh	633	35.5	30.7	1.20	7.2	62.1	9,950
50 mesh	100 mesh	365	20.3	31.9	1.40	7.3	60.8	9,700
100 mesh	200 mesh	144	8.0	35.4	1.30	7.8	56.8	9,230
200 mesh	----------	360	20.0	46.9	.50	8.5	44.6	7,140
Total		1794	100.0	------	------	------	------	------
Average		------	------	34.4	1.08	8.0	57.6	9,309

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
------	3/32"	43.5	8.0	27.1	26.7	29.4	74.7	70.6	15.2
3/32"	3/64"	37.3	8.7	------	------	------	------	------	15.2
3/64"	50 mesh	43.8	7.3	28.7	22.1	27.5	72.5	72.5	13.2

LEHIGH VALLEY COAL COMPANY

Centralia Colliery

This plant prepares 1,500 tons of coal a day. The silt is made through a 1/16-inch screen. The silt was formerly dewatered in the usual form of settling tank and piled up on a high bank by an inclined scraper conveyor. During accumulation of this bank 3/32-inch screens were used. The bank is about 200 feet high, is conical in shape, and contains about 600,000 tons of silt and culm. Another smaller culm and silt bank adjacent to this bank was being worked by steam shovel.

When the samples were collected the silt from the breaker was flushed out into a basin which partly surrounds these old culm banks and extends into and fills an old stripping. The water collects in a pool at the farthest extremity of this basin, and seeps down through the culm and rock embankment that retains the silt. There was no surface overflow of water at the time of sampling.

The 600,000-ton culm bank and the new silt basin were sampled separately with the 10-foot sampling tube. The silt basin contains 3.7 per cent of rice size and 6.6 per cent barley, but these sizes are high in ash and only 50 to 75 per cent coal. The culm bank contains 22,000 tons of material of buckwheat size, 15,000 tons of rice size, and 16,000 tons of barley size. This is about 60 per cent recoverable coal of commercial grade.

Analysis of new silt bank, Centralia Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	110	3.7	51.3	.50	5.3	43.4	6,790
3/16″	3/32″	200	6.6	34.3	.80	6.5	59.2	9,450
3/32″	3/64″	534	17.7	30.8	.50	6.2	63.0	9,980
3/64″	50 mesh	1220	40.4	33.0	.60	6.5	60.5	9,530
50 mesh	100 mesh	595	19.7	39.6	.60	6.9	53.5	8,470
100 mesh	200 mesh	197	6.5	45.2	.40	6.8	48.0	7,500
200 mesh	----------	164	5.4	51.3	.40	7.9	40.8	6,480
Total		3020	100.0	----------	----------	----------	----------	----------
Average		----------	----------	36.5	.56	6.6	56.9	8,997

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	45.9	7.3	27.1	28.0	27.0	72.0	73.0	15.0
3/64″	50 mesh	35.8	5.7	32.1	24.1	32.1	75.0	67.9	14.4

Analysis of old bank sample, Centralia Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16″	136	3.7	57.4	.20	7.4	35.2	5,830
5/16″	3/16″	88	2.4	58.1	.60	7.1	34.8	5,620
3/16″	3/32″	100	2.7	38.9	.60	6.1	55.0	8,630
3/32″	3/64″	766	20.6	27.3	.70	6.9	65.8	10,530
3/64″	50 mesh	1592	42.8	28.0	.60	6.8	65.2	10,370
50 mesh	100 mesh	760	20.4	36.0	.80	6.8	57.2	9,010
100 mesh	200 mesh	154	4.1	51.3	.50	7.2	41.5	6,350
200 mesh	----------	124	3.3	51.8	1.00	7.9	40.3	6,330
Total		3720	100.0	----------	----------	----------	----------	----------
Average		----------	----------	33.3	.66	6.9	59.8	9,498

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	52.3	7.0	25.0	28.4	22.7	53.1	77.3	13.9
3/64″	50 mesh	43.3	6.4	32.0	24.4	24.7	74.5	75.3	14.0

HAZLE BROOK COAL COMPANY

Girard Colliery

This plant produces 500 to 600 tons of coal a day from third and fourth mining. It is prepared over Simplex jigs and Deister-Overstrom tables. The silt that passes through 1/16-inch perforations is settled in a small basin and the water and slime overflows into Mahanoy Creek. The basin was sampled with the 10-foot sampling tube. It contains 1.8 per cent oversize material (over 3/32 inch) but it is very high in ash content.

An old culm and silt bank, put out prior to 1909, has been partly rewashed. The finest screen used at that time carried 3/32-inch holes. This material is mixed with slate and culm. The bank was sampled by 10-foot holes and channel samples taken of exposed vertical sections. It contains 1.8 per cent of nut size material but this is only 20 per cent coal (by visual inspection). The other commercial sizes are high in ash content. This bank contains a total of 90,000 tons of culm and silt.

Analysis of new silt bank sample, Girard Mammoth Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	30	1.8	53.8	1.20	5.9	40.3	6,340
3/32″	3/64″	245	14.8					
3/64″	50 mesh	780	47.3	58.2	.50	4.8	37.0	5,690
50 mesh	100 mesh	390	23.6	57.1	.50	5.1	37.8	5,850
100 mesh	200 mesh	100	6.1	54.9	.70	6.0	39.1	6,340
200 mesh	------------	105	6.4	59.4	.50	6.7	42.9	6,690
Total		1650	100.0	----------	----------	----------	----------	----------
Average		----------	----------	56.5	.63	5.3	38.2	5,939

Analysis of old bank, silt and culm, Girard Mammoth Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16″	87	1.8	----------	----------	----------	----------	----------
11/16″	9/16″	3	.1	----------	----------	----------	----------	----------
9/16″	5/16″	92	1.9	58.0	.30	6.5	35.5	5,570
5/16″	3/16″	206	4.3	56.7	.20	6.7	36.6	5,810
3/16″	3/32″	890	18.5	47.1	.40	6.1	46.8	7,260
3/32″	3/64″	1110	23.0	41.2	.50	6.5	52.3	8,230
3/64″	50 mesh	1300	27.0	41.3	.60	6.4	52.3	8,100
50 mesh	100 mesh	688	14.3	44.2	.40	7.2	48.5	7,640
100 mesh	200 mesh	234	4.8	47.5	.50	8.4	44.1	6,990
200 mesh	------------	210	4.3	50.7	.70	9.7	39.6	6,350
Total		4820	100.0	----------	----------	----------	----------	----------
Average		----------	----------	44.5	.49	6.8	48.7	7,625

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
5/16"	3/16"	23.0	7.0	17.0	24.5	60.0	81.5	40.0	14.4
3/16"	3/32"	20.5	5.5	26.2	20.3	53.3	79.8	46.7	13.8
3/32"	3/64"	23.4	5.0	31.9	14.2	44.7	79.0	55.3	10.3

DODSON COAL COMPANY

Locust Mountain Colliery.

This colliery produces about 50,000 tons of coal per month. The breaker handles coal from open-cut mining, underground mining, and a small proportion of bank coal. The silt passes through a screen with some plates punched with 1/16-inch perforations and others with 3/32-inch perforations. The silt that passes through this screen goes to settling tank from which it is elevated to the storage tank by a perforated bucket elevator and inclined conveyor. The overflow water and slime flows away to the creek. This water was sampled at half-hourly intervals and was measured by timing floats in the flume. The rate of discharge of silt on the day it was sampled was 71 tons per day. The breaker handled 2,008 tons of raw mine-run coal on this day. This was composed of 330 cars from underground workings, 365 cars of strip coal, and 5 cars of bank coal.

The production of dewatered silt was estimated by measuring it in an improvised pocket in the elevator discharge chute. This pocket was first calibrated by weighing 5 consecutive pocketsful of silt as it was discharged from the elevator and by taking a moisture sample in order to reduce the final estimate of daily production to the moisture-free basis. The production of dewatered silt measured in this way on the day of sampling was 188 tons, dry. The total production including slimes which were carried away by the settling tank overflow water was 259 tons.

The silt bank has a marginal embankment of silt. Only sufficient water to spread the silt is poured onto the bank with it. This drains away through the bank, and carries very little solids into the creek. The bank was sampled with the 10-foot sampling tube. It contains 8.6 per cent of barley and rice size coal with 27 to 29 per cent ash content.

Analysis of solids in effluent water from settling tank, Locust Mountain Colliery

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	50 mesh	65	5.2?	20.8	3.7	26.3	.70	5.9	67.8	10,490
50 mesh	100 mesh	296	23.6	94.4	16.8	25.2	.50	5.9	68.9	10,710
100 mesh	200 mesh	204	16.2	64.8	11.5	37.3	.50	6.8	55.9	8,740
200 mesh	------------	694	55.0	220.0	39.1	61.1	.70	8.3	30.6	4,790
Total		1257	100.0	400.0	71.1	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	47.0	.62	7.4	45.6	7,123

Analysis of silt bank sample, Locust Mountain Colliery

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	30	.8	27.8	.80	5.1	67.1	10,390
3/16″	3/32″	281	7.8					
3/32″	3/64″	928	25.8	28.3	.80	5.6	66.1	10,330
3/64″	50 mesh	1500	41.8	32.0	.90	5.9	62.1	9,710
50 mesh	100 mesh	572	15.9	46.6	.60	7.0	46.4	7,320
100 mesh	200 mesh	134	3.7	54.3	.70	9.2	36.5	5,780
200 mesh	------------	152	4.2	47.5	.90	7.2	45.3	7,080
Total		3597	100.0					
Average				34.5	.81	6.1	59.4	9,293

MAHANOY CREEK

The largest accumulation of culm and silt in the streams of the anthracite region is between Mahanoy City and Girardville, on Mahanoy Creek. This deposit has accumulated from numerous collieries for over seventy-five years. The creek bottom has been raised and is now kept open by dredging. The railroad tracks run through the culm and silt deposits on embankments which are a few feet above the general level of the stream. The deposits range from a few feet to 40 feet deep. It was sampled by 10-foot sample holes spaced 500 feet apart up and down the creek, and 100 feet apart transversely of the valley.

Analysis of silt accumulations in Mahanoy Valley near Girardville.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	110	4.6	36.5	.50	7.2	56.3	9,060
3/16″	3/32″	118	4.9					
3/32″	3/64″	276	11.4	25.7	.60	6.1	68.2	10,730
3/64″	50 mesh	626	25.9	28.4	.60	5.1	66.5	10,260
50 mesh	100 mesh	727	30.1	37.0	.60	4.9	58.1	8,970
100 mesh	200 mesh	298	12.3	54.4	.50	6.9	38.7	6,300
200 mesh	------------	260	10.8	63.9	1.00	7.1	29.0	4,320
Total		2415	100.0					
Average				38.5	.62	5.8	55.7	8,683

Analysis of samples collected in Mahanoy Creek at Gilberton.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	512	10.7	25.6	.60	5.3	69.1	10,810
3/32″	3/64″	1032	21.7	19.2	.50	5.3	75.5	11,780
3/64″	50 mesh	1870	39.2	22.1	.60	5.9	72.0	11,330
50 mesh	100 mesh	884	18.6	29.8	1.00	6.9	63.3	10,130
100 mesh	200 mesh	230	4.8	43.7	.50	6.1	50.2	8,020
200 mesh	------------	240	5.0	51.9	.60	7.1	41.0	6,420
Total		4768	100.0					
Average				25.8	.65	6.0	68.2	10,744

Analysis of sample collected between Gilberton and Girard Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	300	11.6	43.7	.40	6.4	49.9	7,940
3/16″	3/32″	543	21.0	24.5	.50	5.2	70.3	10,930
3/32″	3/64″	621	24.0	23.8	.60	7.6	68.6	11,120
3/64″	50 mesh	686	26.6	24.4	.50	6.9	68.7	10,940
50 mesh	100 mesh	302	11.7	26.6	.60	6.7	66.7	10,630
100 mesh	200 mesh	64	2.5	32.8	.50	5.8	61.4	9,620
200 mesh	-----------	66	2.6	37.3	.40	7.5	55.2	8,720*
Total		2,582	100.0	----------	----------	----------	----------	----------
Average		-----------	-----------	27.3	.52	6.6	66.1	10,506

MADEIRA-HILL COAL COMPANY (THOMAS COAL COMPANY)

New Boston and Morea collieries

The coal from these collieries is prepared in the breaker at Morea; 1,300 to 1,600 tons of coal per day is shipped from this plant. The raw coal fed to the preparation plant is about 90 per cent fresh-mined and 10 per cent bank coal. The silt passes through 3/32-inch and 1/16-inch perforations. It is dewatered and deslimed in a 60-foot Dorr thickener. The effluent water and slimes from the thickener discharge into Mill Creek. The dewatered silt is conveyed by scraper conveyor to the stock bank or loaded into railway cars for shipment. It was being shipped at the time of sampling. The dewatered silt as loaded for shipment was sampled by taking a shovelful from the conveyor at half-hourly intervals. The effluent water was sampled at half-hourly intervals and measured by timing floats in the flume. The thickener was handling 1,750 gallons of water per minute. The effluent water contains .137 pounds of solids per gallon. It carries away 51 tons of fine silt per day. This contains little coal of commercial grade. The average ash content is 49.7 per cent, and 62.5 per cent of it is finer than 200 mesh. The production of dewatered silt is 120 to 150 tons a day.

The silt bank was sampled by 10-foot holes on 100-foot centers each way. This bank is approximately rectangular in shape. It has an average width of 260 feet and a length of 650 feet. The depth is difficult to ascertain as the silt overlies a rock bank. It is, however, at least 10 feet deep, and contains, therefore, in excess of 50,000 tons; 17.2 per cent of the material is rice and barley coal of 22.3 per cent ash content.

*Analysis of current silt being shipped, New Boston Colliery.**

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	40	1.2	34.5	.50	5.9	59.6	9,270
3/16″	3/32″	46	1.3					
3/32″	3/64″	706	20.8	27.4	.60	5.3	67.3	10,460
3/64″	50 mesh	1,420	41.9	30.4	.50	5.9	63.7	9,950
50 mesh	100 mesh	688	20.3	38.8	.60	5.9	55.3	8,650
100 mesh	200 mesh	274	8.1	46.8	.60	6.5	46.7	7,300
200 mesh	------------	218	6.4	62.6	.50	7.0	30.4	4,540
Total		3,392	100.0	------------	------------	------------	------------	------------
Average		------------	------------	35.0	.55	5.9	59.1	9,150

*Production of silt is 120 to 150 tons per day.

Analysis of solids in effluent water from Dorr thickener, New Boston Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	50 mesh	254	20.4	28.0	6.4	36.1	.70	6.0	57.9	9,170
50 mesh	100 mesh	107	8.6	11.8	2.7	42.6	.60	6.6	50.6	7,940
100 mesh	200 mesh	106	8.5	11.6	2.6	37.7	.50	6.7	55.6	8,720
200 mesh	------------	780	62.5	85.6	19.5	56.8	.50	8.4	34.8	5,410
Total		1,247	100.0	137.0	51.2	------------	------------	------------	------------	------------
Average		------------	------------	------------	------------	49.7	.55	7.6	42.7	6,676

Rate of water flow 1,750 gallons per minute.

Analysis of silt bank sample, New Boston Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	54	2.2	22.3	.40	5.9	71.8	11,240
3/16″	3/32″	362	15.0					
3/32″	3/64″	643	26.8	21.3	.40	5.5	72.7	11,230
3/64″	50 mesh	767	31.9	24.4	.50	6.1	69.5	10,890
50 mesh	100 mesh	378	15.7	31.5	.40	6.0	62.5	9,770
100 mesh	200 mesh	103	4.4	37.2	.40	5.4	57.4	8,870
200 mesh	------------	97	4.0	48.2	.50	7.3	44.5	6,970
Total		2,404	100.0	------------	------------	------------	------------	------------
Average		------------	------------	26.0	.44	5.9	68.1	10,610

LEHIGH VALLEY COAL COMPANY

Park Colliery

The daily production of this colliery is 1,500 to 1,600 tons of prepared coal. It is all fresh-mined coal partly from strip-pits. The silt is made through a combination of 3/32- and /16-inch perforations. It is dewatered and deslimed by a small settling tank. The effluent water and silt from this tank flows into the creek. The settlings are taken up by a perforated bucket elevator and stored on the silt bank. Both products were sampled throughout a day's operation. The rate of production could not be determined.

The old silt and culm bank has been almost entirely taken into the breaker and rewashed. The bank which is now being accumulated contains about 160,000 tons of silt. It contains .3 per cent rice coal and 1.4 per cent of barley size.

Analysis of silt bank sample, Park Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	10	.3 }	24.4	.70	4.8	70.8	10,930
3/16"	3/32"	40	1.4 }					
3/32"	3/64"	893	30.6	21.7	.70	5.2	73.1	11,360
3/64"	50 mesh	1,252	42.8	25.5	.90	5.7	68.8	10,760
50 mesh	100 mesh	544	18.6	33.0	1.00	6.7	60.3	9,580
100 mesh	200 mesh	104	3.6	45.3	1.30	6.6	48.1	7,770
200 mesh	------------	80	2.7	48.0	.60	7.9	44.1	6,920
Total		2,923	100.0	----------	----------	----------	----------	----------
Aerage		------------	------------	27.0	.86	5.8	67.2	10,515

Size		Specific gravity analysis							
Through	Over	Ligher than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	22.2	2.5	46.0	12.0	31.8	70.5	68.2	8.9
3/64"	50 mesh	28.4	3.1	46.1	14.4	25.5	72.1	74.5	10.1

Analysis of current silt production, Park Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	5	.4 }	22.8	.90	6.5	71.7	11,260
3/32"	3/64"	220	17.1 }					
3/64"	50 mesh	710	54.8	24.3	1.00	5.9	69.8	11,032
50 mesh	100 mesh	289	22.3	32.3	.90	6.6	61.2	9,810
100 mesh	200 mesh	42	3.2	49.0	.70	6.7	44.3	6,790
200 mesh	------------	28	2.2	48.8	1.40	7.1	44.1	6,970
Total		1,294	100.0	----------	----------	----------	----------	----------
Average		------------	------------	27.2	.96	6.0	66.8	10,573

Production not measured.

Analysis of solids in effluent water from silt tank, Park Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64″	44	4.3	4.8	--------	30.1	.60	6.6	63.3	9,920
3/64″	50 mesh	310	30.0	33.6	--------	23.6	.80	5.9	70.5	11,160
50 mesh	100 mesh	280	27.1	30.4	--------	26.6	.70	5.9	67.5	10,560
100 mesh	200 mesh	98	9.5	10.6	--------	31.8	.70	5.6	62.6	9,680
200 mesh	------------	300	29.1	32.6	--------	49.3	.60	7.3	43.4	6,840
Total		1,032	100.0	112.0	--------	--------	--------	--------	--------	----------
Average		--------	--------	----------	--------	33.0	.70	6.3	60.7	9,546

Rate of water flow could not be measured.

HAZLE MOUNTAIN COAL COMPANY

Black Ridge Colliery

This is an abandoned colliery near Conyngham. The breaker and entire surface plant, with the exception of railway sidings, has been destroyed. Two banks of fine coal and slate remain. The history of these banks could not be obtained. They now belong to the Scranton Electric Company. Both banks were sampled. The east bank, which is a mixture of culm and silt, contains about 3,500 tons of marketable coal of No. 2 buckwheat size and 20,000 tons of No. 3 buckwheat. The silt bank contains only about 400 tons of No. 2 buckwheat and 13,600 tons of No. 3 buckwheat. About 85 per cent of the material of these sizes is clean coal.

Analysis of southwest bank, Black Ridge Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	10	.4	25.7	.70	7.1	67.2	10,710
3/16″	3/32″	313	13.6					
3/32″	3/64″	612	26.5	27.1	.80	5.6	67.3	10,520
3/64″	50 mesh	794	34.4	33.2	1.40	6.9	59.9	9,500
50 mesh	100 mesh	428	18.6	43.9	1.70	6.7	49.4	7,710
100 mesh	200 mesh	80	3.5	50.0	.70	9.1	40.9	6,600
200 mesh	------------	69	3.0	59.3	.60	9.9	30.8	4,890
Total		2,306	100.0	--------	--------	--------	--------	----------
Average		------------	------------	33.9	1.37	6.7	59.4	9,367

Analysis of east bank, Black Ridge Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	150	4.1	36.5	.40	6.8	56.7	9,040
3/16″	3/32″	747	20.5	16.8	.60	6.1	77.1	12,250
3/32″	3/64″	820	22.5	19.3	.50	6.0	74.7	11,760
3/64″	50 mesh	1,017	27.9	19.7	.50	6.4	73.9	11,650
50 mesh	100 mesh	619	17.0	24.7	.60	6.2	69.1	10,830
100 mesh	200 mesh	146	4.1	35.1	.50	6.9	58.0	9,130
200 mesh	------------	142	3.9	51.4	.40	7.3	41.3	6,400
Total		3,641	100.0	------------	------------	------------	------------	------------
Average		------------	------------	22.4	.53	6.3	71.3	11,243

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16″	3/32″	61.1	6.4	24.4	23.2	14.5	71.0	85.5	11.2
3/32″	3/64″	68.9	3.8	16.7	28.4	14.4	74.2	85.6	10.2

BEAVER MEADOWS.

A very extensive stream deposit has accumulated in the valley of Beaver Creek in the vicinity of Beaver Meadows. This deposit has been accumulating for many years and is still being added to by the breakers along Beaver Creek above the town of Beaver Meadows. This deposit extends for several miles along the creek valley and ranges from 5 to 30 feet deep. The deposit was sampled by 10-foot sample holes, spaced 500 feet apart up and down the creek, and 100 feet apart transversely of the valley. The part which lies above the highway bridge at Beaver Meadows contains considerable proportions of marketable coal.

Analysis of stream deposit in Beaver Creek above highway bridge at Beaver Meadows.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16″	37	.4	28.8	.30	3.3	67.9	10,410
11/16″	9/16″	32	.4					
9/16″	5/16″	410	4.7	19.7	.40	3.7	76.6	11,740
5/16″	3/16″	682	7.8	19.8	.40	4.1	76.1	11,700
3/16″	3/32″	1,340	15.3	20.0	.40	4.5	75.5	11,800
3/32″	3/64″	1,100	21.7	19.8	.40	4.5	75.7	11,670
3/64″	50 mesh	2,194	25.0	22.8	.40	4.7	72.5	11,200
50 mesh	100 mesh	1,400	16.0	32.9	.30	5.5	61.6	9,570
100 mesh	200 mesh	312	3.5	47.3	.30	5.8	46.9	7,270
200 mesh	------------	462	5.2	55.3	.30	7.0	37.7	5,900
Total		8,969	100.0	------------	------------	------------	------------	------------
Average		------------	------------	25.6	.37	4.8	69.6	10,778

Analysis of stream deposit in Beaver Creek below highway bridge at Beaver Meadows.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	182	5.9	20.4	.60	5.9	73.7	11,680
3/16"	3/32"	274	9.0	21.9	.50	4.7	73.4	11,300
3/32"	3/64"	520	16.9	18.0	.40	5.0	77.0	11,910
3/64"	50 mesh	971	31.6	17.6	.40	4.5	77.9	11,970
50 mesh	100 mesh	806	26.2	28.1	.40	5.3	66.6	10,210
100 mesh	200 mesh	118	3.9	42.0	.40	6.5	51.5	8,050
200 mesh	------------	200	6.5	52.8	.40	6.8	40.4	6,260
Total		3,071	100.0	----------	----------	----------	----------	----------
Average		------------	------------	24.2	.42	5.1	70.7	10,904

PARDEE BROTHERS COAL COMPANY

Lattimer Colliery

The daily production of this colliery is 1500 tons. It is prepared over jigs and shaker screens. The finest perforations in the sizing screens are 3/32-inch. The silt and water which pass through this screen goes to a settling tank from which the silt is removed by a perforated bucket elevator and stocked by an inclined scraper conveyor. The overflow water and slime flows away to the canal. This product was sampled at half-hourly intervals during one days operation and was measured by timing floats in the flume. The rate of water flow is 1000 gallons per minute and it carries away 31.2 tons of fine coal a day. This is practically all slime and the loss of marketable sizes of coal is negligible.

The bank that was being used for storage of current silt at the time of sampling contains about 150,000 tons of which 30,000 tons is of No. 3 buckwheat size. A new Rheolaveur washery was under construction. This plant will reclaim the marketable coal in culm banks on this property. A Dorr thickener is installed for dewatering the silt and clarifying washery water.

Analysis of solids in effluent water from silt settling tank, Lattimer Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	6	.5	.7	.1	16.6	.60	4.8	78.6	12,200
3/32"	3/64"	40	3.3	4.9	1.0					
3/64"	50 mesh	263	22.0	32.3	6.9	17.7	.60	4.8	77.5	12,060
50 mesh	100 mesh	266	22.3	32.8	7.0	21.7	.50	4.7	73.6	11,400
100 mesh	200 mesh	140	11.7	17.2	3.7	27.9	.60	5.4	66.7	10,400
200 mesh	------------	480	40.2	59.1	12.5	46.5	.60	7.2	46.3	7,230
Total		1,195	100.0	147.0	31.2	----------	----------	----------	----------	----------
Average		--------	--------	----------	--------	31.3	.58	5.8	62.9	9,782

Analysis of silt bank sample, Lattimer Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	471	19.2	21.7	.60	4.7	73.6	11,490
3/32″	3/64″	945	38.5	21.7	.60	4.5	73.8	11,390
3/64″	50 mesh	795	32.3	25.5	.60	5.1	69.4	10,750
50 mesh	100 mesh	169	6.9	38.7	.70	5.5	55.8	8,640
100 mesh	200 mesh	38	1.5	40.6	.70	7.2	52.2	8,280
200 mesh	----------	40	1.6	48.2	.60	8.7	43.1	6,840
Total		2,458	100.0	----------	----------	----------	----------	----------
Average		----------	----------	24.8	.61	4.9	70.3	10,893

Size		Specific gravity analysis							
		Ligher than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	55.5	6.4	20.0	28.3	24.4	74.9	75.5	12.2
3/64″	50 mesh	30.7	6.0	33.0	20.0	36.4	73.1	63.7	13.3

JEDDO-HIGHLAND COAL COMPANY

Highland No. 2 Colliery

The breaker at this colliery has been shut down since May 1, 1926, and the coal is prepared at the Jeddo No. 5 plant. Old strip pits have been used for storage of silt at this colliery. Three abandoned strippings are now practically filled with fine coal. The oldest and largest of these accumulations was worked during the 1925-26 suspension to obtain power plant fuel. This was sampled by holes over the surface and channel samples on vertical faces exposed in the cut. During the accumulation of this deposit 1/16-inch screens were used to make the smallest size of coal shipped but no auxiliary silt screen was used and much oversize coal was discharged with the silt. The bank contains 1.3 per cent of No. 2 buckwheat coal and 9.4 per cent of No. 3 buckwheat.

Analysis of silt bank sample, Highland No. 2 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	55	1.3	20.0	.40	4.9	75.1	11,620
3/16″	3/32″	392	9.4	15.3	.50	4.8	79.9	12,420
3/32″	3/64″	1186	28.3	16.4	.40	4.5	79.1	12,150
3/64″	50 mesh	1300	31.0	18.7	.40	5.0	76.3	11,820
50 mesh	100 mesh	750	17.9	23.9	.40	5.5	70.6	10,990
100 mesh	200 mesh	176	4.7	30.4	.40	6.1	63.5	10,000
200 mesh	----------	310	7.4	41.2	.50	7.5	51.3	8,030
Total		4189	100.0	----------	----------	----------	----------	----------
Average		----------	----------	20.9	.42	5.2	73.9	11,453

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16"	3/32"	40.8	3.0	46.6	14.5	12.6	65.7	87.4	9.1
3/32	3/64"	48.5	2.8	37.4	34.0	14.1	67.9	85.9	16.4
3/64"	50 mesh	45.2	2.9	38.7	13.5	16.1	69.0	83.9	7.8

JEDDO-HIGHLAND COAL COMPANY

Jeddo No. 5 Colliery.

The normal daily production at this colliery is 1000 to 1200 tons. It is prepared by Lehigh Valley jigs and Deister-Overstrom tables. The silt passes through 3/64-inch perforations. The No 4 buckwheat made over this screen and through 3/32-inch, is mixed with some No. 2 and No. 3 buckwheat and is used in the colliery power plant. The silt, jig slush, and practically all waste water is collected and passed through an auxilliary screen with 3/64-inch perforations before it is flumed out upon the silt bank. No water flows away from the plant except through this flume line to the silt bank. Drainage from the loading pockets and cars is collected in a sump and pumped back into the breaker for re-use.

The material discharged to the bank was sampled at half-hourly intervals and measured by timing floats in the flume. The rate of flow is 1300 gallons per minute and the silt production is 169 tons a day, of which 1 ton is No. 2 buckwheat or rice coal and 1 ton is barley coal.

No change in screening practice has been made during the accumulation of the present 400,000 tons of silt bank. The water that runs off the bank enters old strip pits and probably drains back into the mine workings and goes through the drainage tunnel to Black Creek.

The bank contains only 1.3 per cent of material of marketable size; 5000 tons of No. 2 and No. 3 buckwheat.

Analysis of current silt, Jeddo No. 5 Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	27	.6	3.3	1.0					
3/16"	3/32"	25	.6	3.0	1.0	20.0	.80	4.5	75.5	11,670
3/32"	3/64"	980	22.8	120.2	38.6					
3/64"	50 mesh	1280	29.8	157.0	50.4	20.7	.90	4.0	75.3	11,500
50 mesh	100 mesh	970	22.6	119.0	38.2	25.5	1.10	4.9	69.6	10,770
100 mesh	200 mesh	272	6.3	33.4	10.6	28.5	1.10	5.3	66.2	10,260
200 mesh	------------	742	17.3	91.0	29.2	46.5	1.10	7.0	46.5	7,130
Total		4296	100.0	526.9	169.0	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	26.6	.97	4.9	68.5	10,542

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
------	3/64"	53.3	4.6	31.7	46.5	15.0	67.4	85.0	20.2
3/64"	50 mesh	53.4	5.0	27.3	20.0	19.3	70.0	80.7	10.1

Analysis of bank sample, Jeddo No. 5 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	8	.2	20.8	.60	5.0	74.2	11,530
3/16"	3/32"	51	1.1					
3/32"	3/64"	1064	22.7	21.6	.90	5.5	72.9	11,310
3/64"	50 mesh	2030	43.4	24.0	1.30	5.3	70.7	10,960
50 mesh	100 mesh	934	20.0	32.2	1.80	5.9	61.9	9,580
100 mesh	200 mesh	292	6.2	39.6	.80	6.2	54.2	8,250
200 mesh	------------	300	6.4	50.1	.60	7.4	42.5	6,560
Total		4679	100.0	------------	------------	------------	------------	------------
Average		------------	------------	27.7	1.22	5.7	66.6	10,320

JEDDO-HIGHLAND COAL COMPANY

No. 4 Colliery

This colliery produces about 1500 tons of coal a day. The silt screen contains plates with 1/16-inch and 3/64-inch perforations. The coal that passes through 3/16-inch holes and over this silt screen, is used in the colliery power plant. The average screen analysis of the boiler plant fuel is as follows:

Screen analysis of boiler plant fuel at Jeddo-Highland Coal Co. No. 4 Colliery.

Trade name	Size	Per cent of total
Rice or No. 2 buckwheat	over 3/16	5
Barley or No. 3 buckwheat	3/32 to 3/16	50
No. 2 barley or No. 4 buckwheat	3/64 to 3/32	25
Silt	through 3/64	20

The silt is sometimes flushed into the mine workings and sometimes flumed out on an extensive settling bank, which is about 3000 feet long by 900 feet wide and contains approximately 300,000 tons of silt. The water is not retained upon the bank by embankments but spreads out over it, depositing most of its silt. It then meanders through a wide marsh below the bank and carries the very fine silt with it. Some of the water finally draws back into the mine workings

and some of it goes into Black Creek. The quantity of water discharged upon the bank from the breaker is 1900 gallons per minute. This carries 260 tons of silt per day: 1.7 per cent, or 4.4 tons of this is barley coal. The bank contains 4.6 per cent of barley coal. This amounts to 14,000 tons.

The water which drains from the lip screens and loaded cars is collected in a small catch basin and is pumped back into the breaker.

Analysis of bank sample, Jeddo No. 4 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	114	4.6	30.6	.60	5.7	63.7	10,030
3/32″	3/64″	727	29.5	23.0	.70	5.4	71.6	11,230
3/64″	50 mesh	1000	40.6	25.2	.80	5.8	69.0	10,880
50 mesh	100 mesh	427	17.3	33.4	.70	6.6	60.0	9,510
100 mesh	200 mesh	104	4.2	43.7	.80	5.9	50.0	7,900
200 mesh	----------	93	3.8	50.5	.60	7.3	42.2	6,650
Total		2465	100.0	----------	----------	----------	----------	----------
Average		----------	----------	28.0	.74	5.9	66.1	10,421

Analysis of bank sample, Jeddo No. 4 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	44	1.7	20.6	.80	8.0	71.1	11,600
3/32″	3/64″	749	28.4	19.7	.90	5.1	75.2	11,700
3/64″	50 mesh	1170	44.4	23.4	1.00	5.3	71.3	11,150
50 mesh	100 mesh	270	10.2	26.9	.90	6.3	66.8	10,570
100 mesh	200 mesh	120	4.5	32.2	.90	5.0	62.8	9,620
200 mesh	----------	283	10.8	49.1	.50	7.1	43.8	6,820
Total		2636	100.0	----------	----------	----------	----------	----------
Average		----------	----------	25.8	.90	5.5	68.7	10,718

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	47.4	4.0	37.9	33.4	14.7	69.5	85.3	17.1
3/64″	50 mesh	46.7	4.0	33.3	17.5	20.0	64.9	80.0	9.6

JEDDO-HIGHLAND COAL COMPANY

No. 7 Colliery

This colliery produces 800 to 1100 tons of coal a day. It is prepared over jigs and concentrating tables. All the silt and water from the jigs and sizing screens is collected and screened through 1/16-inch perforations. The silt and water that passes through this screen flows into a settling tank. The silt is picked up by a perforated bucket elevator and hauled to a stock bank. The production of dewatered silt is 120 to 150 tons a day. The overflow water and slime from the settling tank is flumed to Black Creek. The rate of water flow is 1900 gallons per minute. It carries away 51.6 tons of fine coal in a day. None of this loss is of marketable size; 83.1 per cent is finer than 100 mesh. The total production of silt, including that which is dewatered and stored on the bank, and that which flows away to Black Creek is 170 to 200 tons a day. The coal that passes through the rice coal screen and over the silt screen is used for boiler plant fuel. The drainage water from the loaded cars and lip screens flows into an old strip pit from which it drains into the mine workings.

At the time of sampling some silt from the stock pile was being loaded for shipment. The bank coal is .5 per cent rice coal, 3.9 per cent barley coal, 26.7 per cent No. 2 barley and 68.9 per cent silt.

Analysis of bank sample, Highland No. 7 Colliery

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	20	.5 }	18.2	.50	5.2	76.6	11,860
3/16"	3/32"	148	3.9 }					
3/32"	3/64"	1011	26.7	18.8	.60	5.1	76.1	11,810
3/64"	50 mesh	1690	44.6	22.7	.50	5.4	71.9	11,240
50 mesh	100 mesh	660	17.5	33.1	.40	5.6	61.3	9,600
100 mesh	200 mesh	149	3.9	59.3	.20	5.6	35.1	5,230
200 mesh	------------	110	2.9	64.2	.30	7.0	28.8	4,550
Total		3788	100.0	------------	------------	------------	------------	------------
Average		------------	------------	25.9	.49	5.4	68.7	10,695

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	41.2	2.8	43.3	12.0	15.6	78.1	84.5	7.5
3/64"	50 mesh	31.5	2.2	47.9	45.9	20.6	79.9	79.4	28.5

Analysis of solids in effluent water from silt dewatering tank. Highland No. 7 Colliery

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	50 mesh	50	4.7	6.1	2.4	24.5	0.80	7.8	67.7	10,810
50 mesh	100 mesh	340	31.8	41.7	16.4	31.5	0.90	7.8	60.7	9,500
100 mesh	200 mesh	197	18.5	24.2	9.6	39.1	1.10	7.6	53.4	8,360
200 mesh	------------	480	45.0	58.9	22.2	55.2	1.60	11.2	33.6	5,340
Total		1067	100.0	130.9	51.6					
Average						43.2	1.24	9.2	47.6	7,480

HAZLE BROOK COAL COMPANY

Hazle Brook Colliery

The output of this colliery averages 1,000 tons a day. The raw coal is mined in the stripping at Porter's swamp. It is prepared over Simplex jigs and shaker screens. The silt passes through 1/16-inch perforations. It is washed into an abandoned strip-pit near the breaker and the water drains into old underground workings. The water and silt discharged from the breaker was sampled at half-hour intervals and was measured by timing floats in the silt flume. The rate of water flow was 1,425 gallons per minute and the silt production was 159 tons a day. Only 0.4 per cent of the silt discharged is of commercial size (over 3/32-inch screen).

It was impossible to estimate the tonnage of silt in storage because the depth of the strip-pit is unknown.

Analysis of bank sample, Hazle Brook Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	15	.4	1.9	.6					
3/32"	3/64"	452	11.3	55.5	18.0	26.1	.80	4.2	69.7	10,780
3/64"	50 mesh	1172	29.2	143.4	46.4	29.6	1.0	3.8	66.6	10,290
50 mesh	100 mesh	912	22.7	111.5	36.1	31.4	.8	4.3	61.3	9,520
100 mesh	200 mesh	400	10.0	49.1	15.9	37.6	.8	4.9	57.5	8,830
200 mesh	------------	1060	26.4	129.6	42.0	55.1	.6	7.2	37.7	5,870
Total		4011	100.0	491.0	159.0					
Average						37.8	.54	5.0	57.2	8,860

Analysis of bank sample, Hazle Brook Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"							
3/16"	3/32"	22	.8	29.7	.60	4.7	65.6	10,150
3/32"	3/64"	681	26.4	19.0	.80	5.0	76.0	11,950
3/64"	50 mesh	970	37.6	19.2	.70	4.5	76.3	11,900
50 mesh	100 mesh	502	19.4	24.5	.60	4.2	71.3	11,950
100 mesh	200 mesh	196	7.6	38.7	.60	4.7	56.5	8,730
200 mesh	----------	210	8.1	53.1	1.30	6.5	40.4	6,260
Total		2,581	100.0	----------	----------	----------	----------	----------
Average		----------	----------	24.5	.75	4.8	70.7	11,210

HAZLE BROOK COAL COMPANY

Upper Lehigh Colliery

This plant handles a mixture of fresh-mined and bank coal. The daily production is about 600 tons of prepared coal and 150 to 200 tons of silt. At the time of sampling the silt was being loaded into railway cars for shipment. The shipped silt passes through a shaker screen with some segments punched with 3/32-inch holes and some with 1/16-inch holes. It is dewatered by a small settling tank and loaded by a perforated bucket elevator. The overflow water and slime goes down the creek and has built up a shallow silt deposit on the flood plain of the creek for at least ½ mile below the breaker. When the deslimed silt is not loaded directly into cars it is stocked by an inclined scraper conveyor and loaded out later as market conditions warrant. This stock bank contained about 30,000 tons at the time of sampling.

Analysis of bank sample, Upper Lehigh Colliery

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	20	1.2	18.6	.50	6.4	75.0	11,690
3/32"	3/64"	430	24.7					
3/64"	50 mesh	765	43.8	20.8	.50	6.2	73.0	11,276
50 mesh	100 mesh	395	22.7	26.8	.50	7.9	65.3	10,310
100 mesh	200 mesh	70	4.0	44.1	.60	8.5	47.4	7,440
200 mesh	----------	62	3.6	50.9	.50	10.1	39.0	6.300
Total		1,742	100.0	----------	----------	----------	----------	----------
Average		----------	----------	23.6	.51	6.9	69.5	10,829

WEST END COAL COMPANY

Mocanaqua Colliery

This plant prepares 1700 tons of coal a day over Simplex and Menzies jigs. The silt passes through 1/16-inch perforations. No. 4 buckwheat is made through 1/8 and over 1/16 inch perforations. This size is also stocked on the silt bank when it is unmarketable. The silt (and No. 4 buckwheat when stored) is dewatered in a settling tank with a perforated bucket elevator which delivers the dewatered silt to an inclined stocking conveyor. The bank has been accumulated since 1923 and there has been no change in the size of screens during that time. This is one of the collieries at which the preliminary study of sampling methods was made. A detailed description of the bank and the methods of sampling have been given. The bank contains 0.9 per cent (500 tons) of No. 2 buckwheat coal and 16.8 per cent (8500 tons) of No. 3 buckwheat.

The silt settling tank overflows 325 gallons of water per minute. This flows into Susquehanna River and carries about 4 tons of fine solids a day. No coal of commerical grade is lost with this water; 80.9 per cent of it will pass through a 100-mesh sieve. The current silt production is about 150 tons a day.

Water draining from the cars, lip screens, and loading pockets flows directly into the river. It carries a comparatively large load of solids and some coal of marketable size.

Analysis of solids in breaker water, Mocanaqua Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16″	4	.16	------	------	------	------	------
11/16″	9/16″	5	.20	------	------	------	------	------
9/16″	5/16″	10	.40	------	------	------	------	------
5/16″	3/16″	25	1.00	------	------	------	------	------
3/16″	3/32″	431	17.4	19.8	.72	6.3	73.9	11,890
3/32″	3/64″	781	31.5	21.3	.74	5.6	73.1	11,600
3/64″	50 mesh	621	25.1	25.7	.87	6.4	67.9	10,880
50 mesh	100 mesh	307	12.4	30.1	.96	6.2	63.7	10,130
100 mesh	200 mesh	122	4.9	31.4	1.19	7.4	61.2	9,860
200 mesh	------	170	6.9	29.7	1.09	8.1	52.2	8,420
Total		2,476	100.0	------	------	------	------	------
Average		------	------	25.1	.84	6.3	68.6	10,976

Analysis of combined bank sample, Mocanaqua Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	------	.9	16.8	.86	9.1	74.1	12,290
3/16″	3/32″	------	16.1	20.4	.64	6.1	73.5	11,660
3/32″	3/64″	------	31.7	21.9	.79	6.8	71.3	11,390
3/64″	50 mesh	------	30.2	23.4	.73	6.5	70.1	11,180
50 mesh	100 mesh	------	14.2	27.5	.79	7.3	65.2	10,720
100 mesh	200 mesh	------	4.4	31.4	.87	6.8	61.0	9,590
200 mesh	------	------	2.5	38.2	.99	8.5	53.2	8,570
Total		------	------	------	------	6.7	69.5	11,122
Average		------	------	23.7	.76	------	------	------

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16"	3/32"	68.7	9.3	18.9	28.7	12.4	69.5	87.6	13.5
3/32"	3/64"	64.5	7.9	23.2	32.3	12.3	71.9	87.7	14.4
3/64"	50 mesh	62.3	8.7	21.8	30.3	15.9	72.5	84.1	14.3
50 mesh	100 mesh	56.7	8.2	21.3	29.4	22.0	75.2	78.0	14.0

Analysis of solids in silt tank overflow water, Mocanaqua Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
3/16"	3/32"	2	.4	.245	.016					
3/32"	3/64"	8	1.4	.982	.062	20.4	.83	8.5	71.1	11,660
3/64"	50 mesh	10	1.8	1.455	.092					
50 mesh	100 mesh	86	15.5	10.56	.67					
100 mesh	200 mesh	122	23.1	14.90	.94	24.1	.78	6.7	69.2	11,070
200 mesh	------------	320	57.8	39.20	2.48	41.0	.98	8.8	50.2	8,090
Total		548	100.0	67.2	4.20					
Average						33.2	.90	8.2	58.6	9,460

SUSQUEHANNA COLLIERIES COMPANY

Nanticoke No. 7 Colliery

The main preparation plant on this property handles about 3,000 tons of coal a day. There is also a washery that handles bank coal only. From 4 to 5 cars of steam coal are produced each day at the washery. This plant handles only the steam sizes in the bank-run coal. The domestic sizes are prepared in a Chance sand flotation plant operated by a leasing company. The steam coal screened out of the feed to the Chance separators is treated in the jig washery.

The fresh-mined coal handled in the main breaker is prepared over jigs and shaker screens, the finest of which has 3/32-inch perforations. The silt that passes through this screen is deslimed by a small settling tank and inclined scraper conveyor. The water and fine silt that overflow this tank are discharged into the creek. The coarser deslimed silt removed from the tank by the conveyor is used for boiler plant fuel. The silt production is 350 to 450 tons a day, including the fines discharged to the creek. About 200 tons per day which is produced at the Glen Lyon Colliery is also used at this power plant. A screen analysis of this fuel made from a representative sample from the stock pile at the power plant showed it

to be a composite of 1.8 per cent No. 2 buckwheat, 22.1 per cent No. 3 buckwheat, and 76.1 per cent deslimed silt from which practically all the dust finer than 100 mesh is removed by the settling tank. The silt produced at the washery varies from 300 to 500 tons a day, and is deslimed by a similar tank and stocked in a bank for a reserve supply of boiler plant fuel. The power plant operator reported satisfactory operation with this fuel except when it contained an excessive quantity of water. A sample of the ash pit refuse obtained from two cars produced on the day of sampling contained 46.5 per cent combustible material.

Silt was being discharged into Newport Creek in considerable quantity at three points (1) waste water from pockets and lip screens in the breaker; (2) overflow of silt desliming tank; (3) waste water from the washery.

The discharge from the breaker could not be measured. It carries 52 grams of silt to the gallon. The overflow from the washery silt desliming tank joins with the breaker silt and passes through the settling tank that prepares this product for boiler fuel. This bank overflows 82.4 tons of solids per day. There is no coal of commerical size in it. The washery discharges 400 gallons of water per minute and carries away about 16 tons of fine solids a day. The total quantity of silt handled daily at this colliery is 800 to 1100 tons. The boiler plant uses 500 tons a day.

There were at one time very extensive accumulations of culm and silt on this property but it has been very largely cleaned up. The culm bank which remains contains about 30,000 tons of recoverable coal and the silt bank contains 35,000 tons of which, roughly, 350 tons is No. 2 buckwheat, and 3,000 tons is No. 3 buckwheat.

Analysis of boiler plant fuel,—fine coal from No. 7 breaker, No. 7 washery and Glen Lyon breaker.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	100	1.8	19.7	0.61	7.7	72.6	11,430
3/16"	3/32"	1195	22.1	18.0	0.77	7.2	74.8	11,950
3/32"	3/64"	2104	38.9	19.8	0.89	6.8	73.4	11,710
3/64"	50 mesh	1680	31.1	24.5	.99	7.3	68.2	10,920
50 mesh	100 mesh	262	4.8	39.0	.69	8.1	52.9	8,500
100 mesh	200 mesh	47	0.9	43.8	1.10	9.5	46.	7,310
200 mesh	------------	20	0.4	45.2	1.16	14.3	40.5	7,090
Total		5408	100.0					
Average		------------	------------	22.1	.88	7.2	70.7	11,300

Analysis of boiler fuel dewatering tank overflow water—silt from No. 7 breaker & washery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64″	49	1.5	6.0	1.2	15.5	.93	7.1	77.4	12,490
3/64″	50 mesh	409	12.6	50.4	10.4	12.5	.77	6.9	80.6	12,340
50 mesh	100 mesh	1382	42.5	170.0	35.0	18.0	.74	6.8	75.2	11,850
100 mesh	200 mesh	594	18.2	72.8	15.0	30.6	.76	7.5	61.9	9,770
200 mesh	------------	820	25.2	100.8	20.8	45.4	1.18	9.1	45.5	7,430
Total		3254	100.0	400.0	82.4					
Average						26.5	.86	7.5	66.0	10,429

Analysis of solids from washery waste water (bank coal), No. 7 Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64″	352	24.0	43.2	3.8	28.8	1.66	7.0	64.2	10,290
3/64″	50 mesh	614	41.9	75.4	6.7	26.9	1.69	7.6	65.5	10,520
50 mesh	100 mesh	270	18.4	33.1	3.0	30.5	1.62	7.6	61.9	9,930
100 mesh	200 mesh	120	8.2	14.8	1.3	40.1	1.36	7.8	52.1	8,300
200 mesh	------------	110	7.5	13.5	1.2	49.8	.69	9.6	40.6	6,680
Total		1466	100.0	18.0	16.0					
Average						30.8	1.56	7.6	61.6	9,880

Analysis of silt bank sample, No. 7 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	95	1.1	18.6	.70	6.8	74.6	11,880
3/16″	3/32″	675	8.2	20.2	.89	6.9	72.9	11,630
3/32″	3/64″	2092	25.4	22.6	.98	7.6	69.8	11,330
3/64″	50 mesh	3308	40.1	25.8	.66	7.3	66.9	10,900
50 mesh	100 mesh	1430	17.3	30.4	.63	7.5	62.1	9,900
100 mesh	200 mesh	420	5.1	37.0	.54	8.1	54.9	9,070
200 mesh	------------	232	2.8	46.5	.64	11.3	42.2	7,140
Total		8252	100.0					
Average				26.4	.75	7.6	66.0	10,232

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16"	3/32"	75.2	6.4	13.1	27.9	11.7	74.3	88.3	9.6
3/32"	3/64"	64.1	5.8	19.1	26.5	16.8	70.5	83.2	10.5
3/64"	50 mesh	43.5	5.7	28.0	18.8	28.5	70.9	71.5	10.8

GEORGE F. LEE COAL COMPANY

Chauncey Colliery.

This plant prepares about 550 tons of coal from underground and open cut operations in the Ross and Red Ash beds. Also some bank coal is usually mixed with the fresh-mined coal in the breaker feed. The coal is prepared by the Chance sand flotation process in two 7½ foot cones either of which will handle the entire tonnage of the plant. Normally only one machine is operated at a time when treating fresh-mined coal. All sizes from No. 1 buckwheat to egg are treated together. The smaller sizes are not washed. After passing through the cones the washed coal passes over a shaker with 3/32 inch perforations to remove silt and sand and these are separated by a 1/16-inch screen. The sand and fine silt passing through this screen and through the finest screen of the sizing shakers are collected in a round tank 13 feet in diameter which is a final separator for the sand and silt. The overflow water from this tank and the silt from the sizing shakers are flumed to a settling basin. The silt screened out of the mine run coal before treatment is discharged upon a separate bank.

The material in both these silt lines was sampled at half hourly intervals during one day of operation and the rate of flow was measured by timing floats. The rate of silt discharge from the primary shakers was 478 tons a day. This contained only 0.2 per cent of oversize coal. The fines discharged from the washed coal sizing shakers and the sand sump amounted to 12 tons a day. This carried 0.8 per cent oversize on a 3/32-inch screen. The sand sump alone overflows an average of about 200 gallons of water per minute and carrying 10 grams of solids per gallon. This totals one ton of coal a day.

The culm bank which contains 50,000 tons has been burned over and is overlain with 6 to 12 feet of rock. It is being uncovered by a clam-shell bucket excavator and is being put through the preparation plant. The old silt bank which was accumulated before the property was acquired by the George F. Lee Coal Company contains 1 per cent of No. 2 buckwheat coal and 10.8 per cent of No. 3 buckwheat coal of 18.9 per cent ash. This means approximately 5,000 tons of steam coal of these sizes.

Analysis of current silt from sizing shakers, Chauncey Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	6	.8	.8	.1}	24.2	.70	6.1	69.7	11,050
3/32"	3/64"	200	26.8	27.2	3.2}					
3/64"	50 mesh	287	38.5	39.1	4.6	28.4	.80	7.0	64.6	10,370
50 mesh	100 mesh	137	18.4	18.7	2.2	48.9	.30	5.8	45.3	6,740
100 mesh	200 mesh	41	5.5	5.6	.7	48.0	.50	7.0	45.0	7,480
200 mesh	------------	75	10.0	10.1	1.2	53.1	.60	9.2	37.7	6,110
Total		746	100.0	101.5	12.0	-------	-------	-------	-------	-------
Average		-------	-------	-------	-------	34.6	.65	6.7	58.7	9,305

Analysis of current silt from desliming shakers, Chauncey Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	7	0.2	3.0	.1}	28.0	.80	6.2	65.8	10,440
3/32"	3/64"	507	16.3	242.6	7.8}					
3/64"	50 mesh	1235	39.6	589.2	18.9	33.9	1.04	6.7	59.4	9,450
50 mesh	100 mesh	665	21.3	316.9	10.2	36.3	1.10	6.9	56.8	9,030
100 mesh	200 mesh	247	7.9	117.6	3.8	41.8	1.40	7.2	51.0	8,110
200 mesh	------------	458	14.7	218.7	7.0	52.5	.70	9.2	38.3	6,150
Total		3119	100.0	1488.0	47.8	-------	-------	-------	-------	-------
Average		-------	-------	-------	-------	36.8	.99	7.1	56.1	8,933

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
------	3/64"	55.1	10.5	19.4	27.1	25.5	75.5	74.5	14.8
3/64"	50 mesh	42.3	10.1	26.6	26.7	31.1	72.7	68.9	16.5

Analysis of new silt bank, Chauncey Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	165	3.4	31.7	.70	8.8	59.5	9,490
3/32"	3/64"	950	19.3	29.6	.60	8.0	62.4	9,800
3/64"	50 mesh	1,560	31.7	26.5	.60	8.3	65.2	10,430
50 mesh	100 mesh	1,150	23.4	30.7	.60	7.7	61.6	9,830
100 mesh	200 mesh	290	5.9	34.7	.60	7.9	57.4	8,910
200 mesh	------------	800	16.3	44.6	.70	9.6	45.8	7,310
Total		4,915	100.0	-------	-------	-------	-------	-------
Average		-------	-------	31.7	.62	8.3	60.0	9,538

Analysis of old bank, Chauncey Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	15	1.0 }	18.9	.50	6.6	74.5	11,760
3/16"	3/32"	162	10.8 }					
3/32"	3/64"	335	22.3	18.7	.40	6.3	75.0	11,820
3/64"	50 mesh	372	24.8	20.5	.50	6.8	72.7	11,430
50 mesh	100 mesh	347	23.1	23.3	.60	8.6	68.1	11,020
100 mesh	200 mesh	137	9.1	31.5	.50	8.9	59.6	9,440
200 mesh	------------	132	8.8	44.6	.70	9.6	45.8	7,310
Total		1,500	100.0	----------	----------	----------	----------	----------
Average		----------	----------	23.6	.52	7.6	68.8	10,906

Chance process performance on coal at Chauncey Colliery.

Specific gravity	Raw coal		Cleaned coal		Refuse	
	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
			STOVE			
Float on 1.6	81.2	8.3	82.6	8.5 }	35.0	39.4
1.6 to 2.0	12.1	33.5a	13.4	19.7 }		
Sink 2.0	6.7	72.0b	4.0	36.4	65.0	69.2
			NUT			
Float on 1.5	43.50	5.4	32.60	4.9	.06	5.9
1.5 to 1.6	37.85	10.6	56.60	10.6	.54	9.9
1.6 to 1.75	6.57	26.3	8.64	26.2	8.88	11.4
1.75 to 1.90	2.57	41.0	1.65	37.1	4.60	[illegible]9.2
Sink in 1.9	9.55	75.2	.52	61.1	85.95	70.5
			PEA			
Float on 1.5	33.50	4.5	18.39	5.0		
1.5 to 1.6	42.40	11.2	67.00	9.0	.61	10.1
1.6 to 1.75	8.64	25.9	11.20	22.7	3.20	24.7
1.75 to 1.9	3.01	40.5	1.62	39.4	13.59	37.7
Sink 1.9	12.40	76.7	1.78	56.2	82.60	73.2
			BUCKWHEAT			
Float on 1.5	31.05	4.0	15.95	3.8		
1.5 to 1.6	41.05	9.5	65.80	8.8	1.21	8.2
1.6 to 1.75	9.26	25.6	12.93	22.5	3.03	25.6
1.75 to 1.9	3.07	40.7	2.73	40.0	9.82	38.0
Sink in 1.9	15.61	74.2	2.55	62.3	85.95	76.5
			RICE			
Float on 1.5	25.45	3.3	12.41	3.6		
1.5 to 1.6	45.75	8.4	63.30	7.3	1.80	8.0
1.6 to 1.75	9.62	23.5	14.31	21.3	2.43	22.5
1.75 to 1.9	2.81	38.7	4.82	37.5	4.78	37.7
Sink in 1.9	16.42	73.7	5.07	65.0	91.00	78.4
			BARLEY			
Float on 1.5	17.30	3.0	16.67	3.2	1.21	4.1
1.5 to 1.6	46.80	7.2	55.60	7.2	3.31	8.3
1.6 to 1.75	15.20	20.8	17.59	21.0	4.52	22.0
1.75 to 1.9	2.53	39.5	3.70	40.4	5.12	37.1
Sink in 1.9	18.15	73.6	6.48	63.3	85.84	79.4

a (1.6-1.75) b (Sink 1.75)

PITTSTON COAL MINING COMPANY

Hadley Colliery.

This colliery produces 400 tons of coal a day. It is prepared over jigs and shaker screens. The silt passes through 3/32-inch perforations and is flushed out upon a settling bank with water. There is no visible drainage of water from this bank. It is commonly believed that the water which is discharged with the silt seeps back into the mine workings through fissures. The rate of water flow in the silt line was measured by timing floats and samples were taken at half-hourly intervals for one day. The silt production is 45 tons a day of which 6.7 tons is oversize coal of commercial grade.

The greater part of the bank was built up before the property came into possession of the present operator and no information on its history could be obtained. It appears to be very old and was originally built up as a settling basin on which the silt and water was impounded by silt embankments raised as the deposit grew. It is now deeply eroded and partly overlain by rock banks. It was sampled by holes in the surface and channel samples of exposed sections. It contains 2.0 per cent (5,000 tons) of No. 2 buckwheat and 10.4 per cent (26,000 tons) of No. 3 buckwheat coal of 24.1 per cent ash content.

Analyses of current silt, Hadley Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	50	.9	5.9	0.4	15.8	.80	7.2	77.0	12,490
3/16"	3/32"	750	13.9	90.2	6.3	19.2	.70	5.2	75.6	11,930
3/32"	3/64"	1,412	26.4	171.3	12.0	18.5	.70	5.4	76.1	12,020
3/64"	50 mesh	1,360	25.3	164.2	11.5	20.5	.70	5.5	74.0	11,730
50 mesh	100 mesh	830	15.3	99.2	7.0	23.9	.70	5.9	70.2	11,420
100 mesh	200 mesh	300	5.6	36.3	2.6	28.4	.70	6.1	65.5	10,440
200 mesh	------------	680	12.6	81.8	5.7	40.2	.80	7.1	52.7	8,310
Total		5,382	100.0	649.0	45.6	-------	-------	-------	-------	-------
Average		--------	--------	--------	--------	23.2	.71	5.7	71.1	11,290

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16"	3/32"	67.1	7.5	21.9	25.5	11.0	73.4	89.0	11.9
3/32"	3/64"	63.4	6.1	24.4	41.4	12.2	74.4	87.8	15.9

Analysis of silt bank. Hadley Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	145	2.0	24.1	.50	6.5	69.4	10,990
3/16"	3/32"	762	10.4	24.1	.50	6.3	69.6	10,970
3/32"	3/64"	1,668	22.7	21.9	.50	6.5	71.6	11,270
3/64"	50 mesh	2,688	36.7	22.7	.50	6.9	70.4	11,160
50 mesh	100 mesh	1,320	18.0	27.3	.50	6.8	65.9	10,410
100 mesh	200 mesh	368	5.0	32.7	.50	7.6	59.7	9,330
200 mesh	------------	385	5.2	39.6	.50	9.8	50.4	8,110
Total		7,336	100.0	------------	------------	------------	------------	------------
Average		------------	------------	24.9	.50	6.9	66.2	10,777

LEHIGH & WILKES-BARRE COAL COMPANY

Buttonwood Colliery

This colliery maintains an average daily production of 1500 tons of coal prepared by a combination wet and dry breaker. The silt goes through a 3/32-inch screen. It is mixed with crushed jig refuse and flushed out upon an extensive conical bank, from which the excess water flows away to the river, and carries some fine silt. The slate is pulverized to suitable size for mine filling and stocked with the silt to be used for flushing when proper facilities can be obtained. A sample was collected at half-hour intervals during a days operation. At times when a sample was being taken the flow of crushed slate was shut off so as to obtain the normal silt production in the sample alone; later examination of the sample showed that some slate found its way into the flume in spite of this precaution. For this reason the screen anaylsis is not truly representative of the silt available from this operation. The rate of water flow in the silt flume was 1180 gallons per minute. It carries 185 tons of silt a day. Some water which drains from the cars and loading plant is discharged directly into the creek. The rate of flow varies greatly but it was estimated to average about 200 gallons per minute. It contains 30 grams of solids to the gallon, which amounts to about 3 tons a day.

An old silt bank deposited before this property was acquired by the Lehigh & Wilkes-Barre Coal Company was sampled by the surface method with holes spaced on 50 foot centers over the top and sides of bank. It contains about 6,000 tons of No. 3 buckwheat coal of 16.3 per cent ash content.

Analysis of old silt bank, Buttonwood Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	12	.2					
5/16	3/16"	15	.3	16.3	1.0	9.4	74.3	12,3[illegible]0
3/16"	3/32"	822	14.0					
3/32"	3/64"	1,800	30.6	18.0	.9	8.1	73.9	11,910
3/64"	50 mesh	1,930	32.8	22.6	1.5	10.1	67.3	11,080
50 mesh	100 mesh	820	14.0	29.0	1.8	11.3	59.7	10,070
100 mesh	200 mesh	356	6.1	35.2	1.9	11.3	53.5	8,800
200 mesh	------------	125	2.2	45.2	1.8	13.7	41.1	7,240
Total / Average		5,880	100.0	22.5	1.32	9.7	67.8	11,172

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
------	5/16"								
5/16"	3/16"	78.0	5.8	9.8	31.9	12.2	74.0	87.8	8.7
3/16"	3/32"								
3/32"	3/64"	75.4	5.9	10.4	29.1	14.2	74.0	85.8	8.7
3/64"	50 mesh	67.8	5.4	12.9	26.0	19.3	74.5	80.7	10.7

*Analysis of current silt, Buttonwood Colliery.**

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sul-phur	Vola-tile matter	Fixed car-bon	
------	5/16"	320	5.4	34.0	10.0	67.1	.40	10.4	22.5	4,240
5/16"	3/16"	170	2.9	18.3	5.4	59.0	.60	9.4	31.6	5,580
3/16"	3/32"	670	11.2	70.5	20.7	26.9	1.3	7.0	66.1	10,790
3/32"	3/64"	1,470	24.7	155.6	45.7	19.3	1.2	7.0	73.7	12,060
3/64"	50 mesh	1,720	28.8	181.4	53.3	22.2	1.1	7.8	70.0	11,630
50 mesh	100 mesh	780	13.1	82.6	24.2	28.1	1.2	7.7	64.2	10,600
100 mesh	200 mesh	360	6.0	37.8	11.1	37.3	1.3	7.7	55.0	9,300
200 mesh	------------	470	7.9	49.8	14.6	48.3	.5	7.7	44.0	7,170
Total / Average		5,960	100.0	730.0	185.0	29.3	.86	7.6	63.1	10,440

*Contains some slate which was not all bypassed during sampling. The high ash content of the large sizes is probably due to slate which is mixed with silt. The slate is crushed and flushed on to the bank with the silt. The slate was shut off during sampling periods but some large pieces were found in sample.

LEHIGH & WILKES-BARRE COAL COMPANY

Stanton Colliery

This colliery produces 2500 to 3000 tons of prepared coal a day. It is cleaned by a combination of wet and dry processes. The silt that passes through 3/32-inch holes is used for mine filling except at periods when the bore holes are not in operation and part of the silt is diverted to the creek. The current silt was sampled and measured in the flume that carries it to the bore holes. Sample increments were collected at half hour intervals for one day. The rate of silt production was 304 tons a day. It contained 6.2 per cent of oversize coal, mostly No. 3 buckwheat in size. This loss of marketable coal amounts to 19 tons a day. The ash content is 16.5 per cent.

A 150,000 ton bank of silt and culm was accumulated before the practice of underground flushing was adopted. A portion of this bank, amounting to approximately 50,000 tons, is fine silt and 100,000 tons is a mixture of fine culm, silt, and pea size slate. These two parts of the bank were sampled separately. Both contain considerable proportions of good steam coal. The aggregate is about 6,000 tons of No. 2 buckwheat and 19,000 tons of No. 3 buckwheat.

Analysis of silt bank, Stanton Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	20	1.3	15.3	.60	5.4	79.3	12,760
3/16″	3/32″	1,112	16.9					
3/32″	3/34″	515	30.3	16.5	.70	7.2	76.3	12,380
3/64″	50 mesh	480	28.2					
50 mesh	100 mesh	223	13.1	23.2	.70	6.8	70.0	11,170
100 mesh	200 mesh	100	5.9	29.2	.70	7.4	63.4	10,220
200 mesh	------	90	5.3	38.2	.70	8.9	52.9	8,570
Total		1,701	100.0	------	------	------	------	------
Average		------	------	20.0	.68	6.8	73.2	11,804

Analysis of culm bank (containing pea slate).

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	358	5.2	26.5	------	------	------	------
3/16″	3/32″	746	11.0	16.4	.60	6.9	76.7	12,420
3/32″	3/64″	2,132	31.5	16.4	.60	6.6	77.0	12,380
3/64″	50 mesh	1,960	28.8	18.9	.60	6.5	74.6	11,940
50 mesh	100 mesh	880	12.9	23.2	.70	7.1	69.7	11,130
100 mesh	200 mesh	420	6.1	25.9	.80	6.8	67.3	10,600
200 mesh	------	304	4.5	35.4	.70	8.1	56.5	9,070
Total		6,800	100.0	------	------	------	------	------
Average		------	------	19.6	.63	6.8	73.6	11,810

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
------	3/16"	60.1	6.4	18.3	33.5	21.6	76.5	78.4	12.7
3/16"	3/32"	73.6	6.2	17.0	27.5	9.4	70.3	90.6	10.2
3/32"	3/64"	73.5	5.6	22.1	37.5	4.4	63.7	95.6	13.0
3/64"	50 mesh	70.7	5.2	18.3	23.3	11.0	72.0	89.0	8.9

Analysis of current silt (used as filling), Stanton Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	19	0.4	4 5	1.2	16.5	.90	5.5	78.0	12,470
3/16"	3/32"	273	5.8	65.0	17.6					
3/32"	3/64"	1,225	26.1	292.6	79.4	16.9	.90	5.7	77.4	12,410
3/64"	50 mesh	1,396	29.8	334.1	90.6	18.1	.80	6.5	75.4	12,250
50 mesh	100 mesh	807	17.2	192.8	52.3	24.0	.80	5.9	70.1	11,170
100 mesh	200 mesh	403	8.6	96.4	26.1	31.4	1.0	6.8	61.8	9,940
200 mesh	------------	565	12.1	135.6	36.8	42.2	1.0	7.3	50.5	8,090
Total		4,688	100.0	1,121.	304.0	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	22.8	0.87	6.2	71.0	11,418

LEHIGH & WILKES-BARRE COAL COMPANY

Hollenback Colliery

This plant prepares from 1000 to 1200 tons of coal a day in a combination wet and dry breaker. Egg and stove coal produced by the rolls is hand picked and cleaned by spiral pickers. All the smaller sizes and the egg and stove sizes, which pass through the mud-screen are jigged. The smallest size shipped is No. 3 buckwheat or barley coal which is made over a 3/32-inch round-hole screen. The silt that passes through this screen is used for mine filling. The daily silt production is 125 tons. Screening tests made by the company on several cars of mine run coal, before crushing, showed it to contain an average of 8.0 per cent of silt through a 3/32-inch round-hole screen.

All the silt, slate, ashes, and waste water are now flushed into the mine. This practice has been followed since 1900 except for a short period during a recent fire which interfered with operation of the bore holes. During this period a small bank of about 10,000 tons was accumulated. This bank was sampled with the 4-foot tube. It contains 1.1 per cent of No. 2 buckwheat coal and 6.9 per cent No. 3 buckwheat—both of comparatively low ash content.

Prior to 1900, all sizes below No. 1 buckwheat were discarded. A 100,000 ton bank of this culm mixed with some ashes and slate is still unworked. The good coal is mixed with ashes in such a way that cleaning would be difficult. This bank contains 2.2 per cent of No. 2 buckwheat coal (2,200 tons) and 29.9 per cent of No. 3 buckwheat (29,900) tons which are clean enough to market without treatment. The larger sizes in the bank are much higher in ash owing to the presence of cinders and would be hard to recover in marketable condition.

There is no discharge of waste water or fine coal from this property.

Analysis of new silt bank, Hollenback Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	57	1.1	14.1	0.60	5.7	80.2	12,780
3/16″	3/32″	350	6.9	14.0	0.70	5.2	80.8	12,910
3/32″	3/64″	1,160	22.9	15.2	0.70	6.4	78.4	12,640
3/64″	50 mesh	2,016	39.8	18.3	0.80	5.6	76.1	12,200
50 mesh	100 mesh	920	18.2	24.9	1.10	6.4	68.7	11,130
100 mesh	200 mesh	354	7.0	32.5	1.40	6.3	61.2	9,920
200 mesh	----------	210	4.1	42.5	0.80	7.4	50.1	8,072
Total		5,067	100.0	--------	--------	--------	--------	--------
Average		----------	----------	20.4	.86	6.0	73.6	11,832

Analysis of current silt used as filling.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day*	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	60	6.0	30.1	--------	13.3	.80	6.1	80.6	13,010
3/32″	3/64″	245	24.3	122.0	--------	13.9	.80	5.3	80.8	12,820
3/64″	50 mesh	292	28.9	145.1	--------	16.8	.80	5.8	77.4	12,330
50 mesh	100 mesh	185	18.3	91.9	--------	23.9	.90	6.5	69.6	11,030
100 mesh	200 mesh	100	9.8	49.2	--------	31.4	.90	7.1	61.5	9,700
200 mesh	----------	128	12.7	63.7	--------	42.3	1.10	9.2	48.5	7,870
Total		1,010	100.0	502.0	--------	--------	--------	--------	--------	--------
Average		--------	--------	----------	--------	21.8	.87	6.4	71.8	11,428

*Discharge water could not be measured.

Analysis of culm and silt bank, Hollenback Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16″	50	.6*	----------	----------	----------	----------	----------
11/16″	9/16″	23	.3†	----------	----------	----------	----------	----------
9/16″	5/16″	337	4.1	25.0	----------	----------	----------	----------
5/16″	3/16″	1,790	22.0	13.8	.50	6.1	80.1	12,600
3/16″	3/32″	2,430	29.9	12.8	.50	6.5	80.7	12,690
3/32″	3/64″	1,450	17.8	14.1	.60	7.5	78.4	12,540
3/64″	50 mesh	1,175	14.4	16.7	.60	8.7	74.6	12,090
50 mesh	100 mesh	490	6.0	22.9	.50	8.7	68.4	10,530
100 mesh	200 mesh	210	2.6	28.5	.50	10.2	61.3	8,990
200 mesh	----------	185	2.3	38.2	.40	12.4	49.4	8,170
Total		8,140	100.0	----------	----------	----------	----------	----------
Average		----------	----------	15.5	.53	7.4	77.1	12,235

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
9/16″	5/16″	49.5	12.7	43.2	32.4	7.3	76.6	92.7	21.9
5/16″	3/16″	72.9	5.0	21.2	20.9	5.9	51.9	94.1	8.6
3/16″	3/32″	57.7	4.8	35.6	15.8	6.7	70.0	93.3	9.0
3/32″	3/64″	72.5	15.6	19.2	22.7	8.3	71.9	91.7	16.0
3″64″	50 mesh	53.7	4.5	32.3	17.1	14.0	73.5	86.0	9.2

*All slate and ashes.
†Hand picked, 39 per cent coal, 61 per cent slate and ashes.

KINGSTON COAL COMPANY.

No. 4 Colliery.

This plant prepares 1,000 tons of coal a day, by a combination of dry and wet processes of treatment. The egg, stove and nut sizes are cleaned by Emory pickers and spirals and the finer sizes are cleaned by jigs; 1,000 gallons of water per minute is used in the washery. No waste water flows away from the breaker. All the unsaleable products, including the silt which is screened through 3/32-inch holes, the slate and the sludge from the dust collecting tower, is flushed into the mine for filling. This practice has been followed since 1907.

The silt production is about 120 tons per day. It was impossible to sample the clean silt without some admixture of slate from the fine coal jigs. The screen analysis, therefore is not representative of the silt that could be produced at this plant if it were kept separate. The dust in the dry preparation plant is collected by suction hoods and is discharged into a spray tower in which the dust is precipitated

and carried to the bore holes by a stream of water; 90 gallons of water per minute flows from this spray tower and carries 18 grams of dust to the gallon. This amounts to 1700 pounds per day.

Analysis of current silt, containing some slate, Kingston No. 4 Colliery.

Size		Screen analysis	Quantity of solids		Chemical analysis			B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	1,133	13.7	58.4	.80	8.2	33.4	5,516
5/16"	3/16"	140	1.7	39.0	1.00	6.5	54.5	8,710
3/16"	3/32"	363	4.4	20.0	.90	5.9	74.1	11,830
3/32"	3/64"	2,360	28.5	20.2	1.00	5.8	74.0	11,820
3/64"	50 mesh	2,320	28.1	23.7	1.10	6.3	70.0	11,210
50 mesh	100 mesh	1,216	14.7	28.1	1.10	7.8	64.1	10,370
100 mesh	200 mesh	384	4.6	33.3	.90	7.4	59.3	9,550
200 mesh	------------	354	4.3	41.5	1.30	7.5	51.0	8,100
Total		8,270	100.0	------------	------------	------------	------------	------------
Average		------------	------------	29.4	1.02	6.7	63.8	10,304

TEMPLE COAL COMPANY

Harry E Colliery

This plant prepares 1300 to 1500 tons of coal per day. The silt passes through 1/16-inch perforations. It is generally used for mine filling but it is often flushed out upon an extensive bank upon which the water is impounded by a cinder embankment. Solids appear to be completely retained on the bank. There is no surface runoff. The water filters out through the embankment or back into the mine workings.

This bank was sampled by the surface sampling method with 4-foot holes on 200 foot centers. It contains only 1.3 per cent of oversize material or larger than 3/32-inch.

About 200 gallons per minute of waste water from loading pockets and cars flow away from this breaker. This carries about four tons of solids per day to the river.

Analysis of solids in waste water from breaker, Harry E Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sul-phur	Vola-tile matter	Fixed carbon	
------	3/32"	30	5.5	3.6	--------	21.4	.80	6.5	72.1	11,560
3/32"	3/64"	70	12.9	8.6	--------	22.4	.80	6.7	70.9	11,320
3/64"	50 mesh	108	19.8	13.1	--------	24.5	.80	6.9	68.6	10,970
50 mesh	100 mesh	97	17.8	11.8	--------	27.7	.80	7.2	65.1	10,320
100 mesh	200 mesh	55	10.1	6.7	--------	29.2	.80	7.2	63.6	10,060
200 mesh	------------	185	33.9	22.4	--------	42.9	.80	8.8	48.3	7,690
Total		545	100.0	66.2	--------	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	31.3	.80	7.6	61.1	9,726

Analysis of bank sample, Harry E Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	11	.2	23.3	.70	8.5	68.2	11,080
3/16″	3/32″	79	1.1					
3/32″	3/64″	1,360	19.7	20.4	.60	8.6	71.0	11,490
3/64″	50 mesh	2,040	29.6	22.1	.60	7.1	70.8	11,200
50 mesh	100 mesh	1,490	21.6	23.4	.50	7.6	69.0	10,960
100 mesh	200 mesh	770	11.1	30.4	.60	7.2	62.4	9,810
200 mesh	------------	1,150	16.7	45.9	.60	9.6	44.5	7,190
Total		6,900	100.0					
Average		----------	----------	27.0	.58	8.0	64.9	10,187

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32″	3/64″	61.2	5.8	23.8	29.5	15.0	65.5	85.0	12.4
3/64″	50 mesh	60.5	5.0	21.0	25.7	18.5	65.4	81.5	10.3

TEMPLE COAL COMPANY

Forty Fort Colliery

The coal hoisted at this colliery is prepared at the Harry E plant of the same company. Prior to January 1, 1925 it was prepared in a separate breaker near the hoisting shaft and the silt, screened through 3/32-inch holes, was flushed out upon an extensive settling basin surrounded by a rock and cinder embankment. The water drained away through this bank and finally found its way to Susquehanna River. This bank contains about 3,000 tons of material of No. 2 buckwheat size and 8,000 tons of No. 3 buckwheat size but it is only 30 to 50 per cent coal.

Analysis of bank sample, Forty Fort Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	55	1.3	55.1	.30	5.9	39.0	6,380
3/16″	3/32″	160	3.9	35.0	.50	7.2	57.8	9,270
3/32″	3/64″	173	4.2	22.6	.60	7.7	69.7	11,070
3/64″	50 mesh	1,180	29.3	25.6	.60	7.8	66.6	10,710
50 mesh	100 mesh	1,330	32.9	29.7	.60	8.1	62.2	10,040
100 mesh	200 mesh	470	11.6	35.7	.70	8.1	56.2	8,950
200 mesh	------------	680	16.8	52.1	.30	8.9	39.1	6,270
Total		4,048	100.0					
Average		----------	----------	33.1	.55	8.1	58.7	9,442

PENNSYLVANIA COAL COMPANY

No. 6 Colliery.

This plant prepares about 2500 tons per day over Wilmot simplex jigs. The silt is screened through 1/16-inch holes. Silt and waste water from the jigs, loading pockets and cars go by a long flume to the creek. This stream was sampled at half hour intervals throughout a days operation and the rate of flow was measured by timing floats. The rate of water flow was 1100 gallons per minute and the quantity of silt carried was 240 tons per day.

The silt produced at this colliery was formerly stocked in an extensive bank which now contains 300,000 tons. No information could be obtained on the size of screens in use during accumulation of this bank but it apparently received a part, at least, of the production of No. 3 buckwheat coal. The older south portion of the bank is visibly coarser than the north end of the bank and it was sampled separately. The bank is cut up by several deep ravines that greatly facilitated the examination of the silt. It was sampled by 4-foot holes on 200 foot centers over the surface and channel samples were taken in the exposed sections. The coarser part of the bank contains about 220,000 tons and the finer north section contains 80,000 tons. The tonnages of commercial sizes are: No. 2 buckwheat 3500 tons of 17.5 per cent ash content and No. 3 buckwheat 35000 tons of 13.6 per cent ash content.

Analysis of current silt, No. 6 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	32	.8	22.6	.70	6.1	71.3	11,410
3/32"	3/64"	1,118	27.6	17.8	.90	6.1	76.1	12,170
3/64"	50 mesh	1,480	36.2	21.6	.90	6.3	72.1	11,510
50 mesh	100 mesh	720	17.7	26.9	1.20	7.5	65.6	10,640
100 mesh	200 mesh	300	7.4	34.3	.90	7.7	58.1	9,450
200 mesh	----------	404	10.0	46.6	1.20	8.6	44.8	7,190
Total		4,654	100.0					
Average				24.9	.99	6.9	68.1	10,848

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	77.4	5.1	11.5	29.3	11.1	74.5	88.9	7.7
3/64"	50 mesh	68.9	5.8	16.7	28.4	14.4	74.2	85.6	9.0

Analysis of north (finer) portion of silt bank, No. 6 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	680	12.5	15.7	.70	7.9	76.4	12,100
3/32″	3/64″	1,320	24.3	16.3	.60	7.9	75.8	12,050
3/64″	50 mesh	1,508	27.7	24.1	.70	8.1	67.8	10,820
50 mesh	100 mesh	936	17.2	25.2	1.10	9.5	65.3	10,730
100 mesh	200 mesh	480	8.8	30.4	.70	8.5	61.1	9,830
200 mesh	------------	520	9.5	45.9	.50	9.9	44.2	7,190
Total		5,444	100.0					
Average		------------	------------	23.8	.73	8.5	67.5	10,831

Analysis of lower, coarser portion of old silt bank, No. 6 Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	105	1.6	17.5	.60	7.5	75.0	11,900
3/16″	3/32″	970	15.2	12.9	.60	8.0	79.1	12,650
3/32″	3/64″	1,750	27.3	12.4	.60	7.9	79.7	12,690
3/64″	50 mesh	1,634	25.5	13.6	.70	7.9	78.5	12,440
50 mesh	100 mesh	1,118	17.4	16.0	.80	9.8	74.2	12,130
100 mesh	200 mesh	368	5.7	23.7	.70	8.8	67.5	10,770
200 mesh	------------	464	7.3	41.5	.70	9.6	48.9	7,830
Total		6,409	100.0					
Average		------------	------------	16.3	.67	8.4	75.3	12,047

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16″	3/32″	74.4	5.0	19.2	24.5	6.4	70.8	93.6	9.0
3/32″	3/64″	73.9	4.6	20.4	19.8	5.7	64.8	94.3	7.9

PENNSYLVANIA COAL COMPANY

Butler Colliery

From 2500 to 3000 tons of coal is shipped daily from this colliery. It is prepared with Wilmot jigs and shaker screens. The silt is made thru 1/16-inch holes. At the time of sampling a new preparation plant was under construction and the normal method of coal preparation and silt disposal was not in operation. Part of the silt and the drainage water from loading pockets and cars was being flushed into the mine and a part of it was stocked on the rock bank,

and is mixed with the washery refuse. The rate of silt production is estimated at 250 tons per day. Upon completion of construction work all the silt will be used for mine filling. A silt bank containing about 30,000 tons was sampled. It contains about 3500 tons of No. 3 buckwheat coal of 20.1 per cent ash content.

Analysis of silt going to bore-hole, Butler Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/64"	33	4.6	15.6}						
3/64"	50 mesh	69	9.7	32.9}	--------	17.7	.70	5.5	76.8	12,190
50 mesh	100 mesh	243	34.1	115.6	--------	19.9	.80	8.0	72.1	11,840
100 mesh	200 mesh	120	16.9	57.3	--------	30.6	.80	5.7	63.7	10,060
200 mesh	------------	247	34.7	117.6	--------	47.1	1.0	7.6	45.3	7,090
Total		712	100.0	339.0	--------	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	30.8	.85	7.1	62.1	9,940

*Discharge water could not be measured.

Analysis of bank sample, Butler Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
-----	3/16"	20	.5}					
3/16"	3/32"	175	3.9}	20.1	.8	6.9	73.0	11,640
3/32"	3/64"	1,716	35.9	20.8	.9	6.4	72.8	11,490
3/64"	50 mesh	2,130	47.3	25.9	1.5	6.6	67.5	10,660
50 mesh	100 mesh	414	9.2	41.7	3.5	7.9	50.4	8,130
100 mesh	200 mesh	84	1.9	45.6	6.2	9.3	45.1	7,150
200 mesh	------------	60	1.3	42.2	1.5	10.4	47.4	7,620
Total		4,498	100.0	--------	--------	--------	--------	--------
Average		--------	--------	26.0	1.53	6.7	67.3	10,662

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	61.1	6.4	24.4	23.2	14.5	71.0	85.5	11.9
3/64"	50 mesh	51.9	13.0	25.5	24.7	22.6	72.8	77.4	16.8

T. F. QUINN COAL COMPANY

Consolidated Colliery

This colliery was not in operation at the time of sampling. A bank containing 200,000 tons of silt and originally belonging to this property, is now owned by the Scranton Electric Company. No

information on the history of this bank could be obtained. A small abandoned washery and cuts in the bank show that it has been worked. It was sampled by the surface method. This bank contains about 3,000 tons of No. 2 buckwheat and 10,000 tons of No. 3 buckwheat coal.

Analysis of bank at Consolidated Colliery, Avoca.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	76	1.3	34.9	.58	8.1	57.0	9,190
3/16"	3/32"	292	4.9	28.3	.70	8.4	63.3	10,120
3/32"	3/64"	1,135	19.1	27.4	.66	8.7	63.9	10,300
3/64"	50 mesh	2,286	38.6	26.5	.60	8.2	65.3	10,430
50 mesh	100 mesh	1,213	20.5	30.3	.59	8.3	60.9	9,748
100 mesh	200 mesh	450	7.6	31.5	.57	8.1	60.4	9,470
200 mesh	------------	477	8.0	45.6	.48	9.3	45.1	7,250
Total		5,929	100.0	------------	------------	------------	------------	------------
Average		------------	------------	29.6	.60	8.4	62.0	9,907

SCRANTON COAL COMPANY

Pine Brook Colliery

This breaker prepares about 2700 tons of coal per day over Simplex and Ransome jigs. The silt passes through 3/32-inch round holes. It is flushed into the mine for filling. Silt which was being discharged at the time of sampling contained 4 per cent oversize (No. 3 buckwheat). The production could not be measured.

An extensive culm bank that was accumulated during the operation of an earlier dry breaker is leased to an independent operator who has worked over a large part of it. A small portion of this bank, that is not included in the lease hold, was sampled. It is covered with about 10 feet of ashes and a part of it is mixed with ashes. A part of it has been uncovered and opened up by the Scranton Coal Company. This part of the bank and that which is mixed with ashes were sampled separately. The clean part of the bank is exceptionally low in ash content. It contains 12.7 per cent of domestic coal and 64.4 per cent steam coal. The average ash content is 16.5 per cent as compared with 27.1 per cent in the ashy part of the bank.

Analysis of ashy part of bank, Pine Brook Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16"	453	8.7	------------	------------	------------	------------	------------
11/16"	9/16"	118	2.3	------------	------------	------------	------------	------------
9/16"	5/16"	900	17.2	24.7	.55	6.5	68.8	10,730
5/16"	3/16"	1,022	19.6	22.1	.57	7.6	70.3	11.010
3/16"	3/32"	1,026	19.7	22.9	.60	7.6	69.5	10,870
3/32"	3/64"	674	12.9	27.6	.67	8.6	63.8	10,000
3/64"	50 mesh	560	10.7	33.8	.77	10.3	55.9	8,920
50 mesh	100 mesh	308	5.9	39.4	.98	11.1	49.5	7,960
100 mesh	200 mesh	78	1.5	45.5	1.04	11.2	43.3	6,830
200 mesh	------------	78	1.5	56.8	1.30	12.3	30.9	4,960
Total		5,217	100.0	------------	------------	------------	------------	------------
Average		------------	------------	27.1	.66	8.2	64.7	10,152

Analysis of part of bank being worked (1925), Pine Brook Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16″	1,227	9.6	------	------	------	------	------
11/16″	9/16″	395	3.1					
9/16″	5/16″	2,920	23.0	16.0	.54	7.4	76.6	12,070
5/16″	3/16″	2,755	21.8	14.9	.54	8.1	77.0	12,090
3/16″	3/32″	2,490	19.6	14.5	.58	9.0	76.5	12,110
3/32″	3/64″	1,338	10.5	15.3	.63	10.4	79.3	11,930
3/64″	50 mesh	974	7.7	20.3	.87	11.8	67.9	11,160
50 mesh	100 mesh	454	3.5	29.4	1.02	13.6	57.0	9,550
100 mesh	200 mesh	73	.6	30.3	1.11	14.9	54.8	9,410
200 mesh	------	78	.6	47.7	1.59	16.9	35.4	6,350
Total		12,704	100.0					
Average		------	------	16.5	.62	9.0	74.5	11,702

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
11/16″	9/16″	51.9	13.0	25.5	24.7	22.6	72.8	77.4	16.8
3/16″	3/32″	73.9	4.6	20.4	19.8	5.7	64.8	94.3	7.9
3/32″	3/64″	61.1	6.4	24.4	23.2	14.5	71.0	85.5	11.1

Analysis of silt going into mine for filling, Pine Brook Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32″	59	4.0	21.6	.78	6.0	72.4	11,550
3/32″	3/64″	439	29.6	19.2	.81	5.5	75.3	12,000
3/64″	50 mesh	504	34.0	20.4	.83	6.2	73.4	11,770
50 mesh	100 mesh	235	15.8	24.7	.85	6.7	68.6	11,020
100 mesh	200 mesh	107	9.4	28.9	.94	6.9	64.2	10,160
200 mesh	------	139	7.2	41.6	1.02	8.4	50.0	8,080
Total		1,483	100.0					
Average		------	------	23.1	.85	6.3	70.6	11,294

SPENCER COAL COMPANY

Spencer Colliery

This plant ships about 250 tons of coal per day. At the time of sampling, fresh mined coal only was being prepared. Bank coal is sometimes treated. The silt passes through 3/32-inch perforations and is flushed out upon an extensive bank retained by a rock rim. Most of the water filters out through this rock embankment and flows away in clear streamlets that trickle out at its base. A small quantity runs off through one wooden sluiceway, but this also was practically clear at the time of sampling.

Current silt production was sampled and measured by catching the entire stream at regular intervals during one operating day. The average rate of water flow in the silt line was 220 gallons per minute and the silt discharge was 20 tons per day. The percentage of oversize material of commercial size in the silt was unusually large, but these sizes were very high in ash.

The silt bank was started in April, 1924. No change in preparation practice has been made during the accumulation of this bank. It contains about 10,000 tons of silt of which 15.3 per cent is of commercial size (No. 1, No. 2, and No. 3 buckwheat), but these sizes are very high in ash. Some of the refuse from the fine coal jigs is apparently discharged with the silt.

An old silt bank which was accumulated by earlier operators of this property contains 150,000 tons of silt and a culm bank contains 100,000 tons. These banks are said to be about 18 years old and both have been partly worked and are opened up by several cuts that expose interior vertical sections, which greatly facilitated sampling.

The culm bank is traversed by a cut that extends its entire length. The bank was sampled by taking channel samples from top to bottom of the bank at 100 feet intervals along this cut to obtain a composite sample of about 2000 pounds. This bank contains approximately 35,000 tons of prepared sizes and 35,000 tons of steam coal.

The silt bank was sampled by 4-foot holes over the surface and by channel samples in the cuts. While this bank was being built up, the finest screens used contained 3/32-inch perforations but much of the steam coal was also stocked in the bank because of market conditions. Screen analyses showed it to contain 15.8 per cent oversize. Tonnages of commercial sizes of coal in the bank are as follows: No. 1 buckwheat 1500, No. 2 buckwheat 3150, No. 3 buckwheat 19,000.

Analysis of culm bank, Spencer Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
2½	1½	64 lb.	22.9	34.2	----------	----------	----------	----------
1½	11/16″	25 lb.	8.9	----------	----------	----------	----------	----------
11/16″	9/16″	5.46 lb.	2.0	----------	----------	----------	----------	----------
9/16″	5/16″	36 lb.	12.9	18.5	.69	8.0	73.5	11,840
*5/16″	3/16″	----------	10.7	15.0	.67	8.2	76.8	12,390
*3/16″	3/32″	----------	11.6	14.6	.69	8.9	76.5	12,350
*3/32″	3/64″	----------	11.4	14.7	.77	8.9	76.4	12,250
*3/64″	50 mesh	----------	10.8	16.4	.82	9.8	73.8	11,890
*50 mesh	100 mesh	----------	5.5	20.7	.90	10.7	68.6	11,060
*100 mesh	200 mesh	----------	1.8	25.6	.97	11.7	62.7	10,370
*200 mesh	----------	----------	1.5	33.3	1.14	13.1	53.6	8,780
Total		2,705 lb.	100.0	----------	----------	----------	----------	----------
Average		----------	----------	17.0	.76	9.1	73.9	11,921

*These sizes screened from quartered sample.

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	
2½	1½	24.5	11.9	39.3	28.0	36.2	56.0	--------	--------

Analysis of sample of new silt bank, Spencer Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16″	240	5.6	68.3	.63	7.9	23.8	3,870
5/16″	3/16″	165	3.9	63.7	.89	7.9	28.4	4,540
3/16″	3/32″	247	5.8	43.7	1.05	7.7	48.6	7,780
3/32″	3/64″	535	12.5	27.6	.73	7.4	65.0	10,510
3/64″	50 mesh	1,685	39.4	25.4	.58	7.6	67.0	10,770
50 mesh	100 mesh	910	21.3	29.6	.70	7.3	63.1	10,130
100 mesh	200 mesh	280	6.5	35.3	.76	7.8	56.9	9,110
200 mesh	------------	217	5.0	42.9	.90	8.9	48.2	7,800
Total		4,279	100.0	------------	------------	------------	------------	------------
Average		------------	------------	33.0	.69	7.8	59.3	9,532

Analysis of old silt bank, Spencer Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16″	60	1.0	------------	------------	------------	------------	------------
5/16″	3/16″	135	2.1	------------	------------	------------	------------	------------
3/16″	3/32″	810	12.7	16.8	.66	8.3	74.9	12,020
3/32″	3/64″	2,017	31.5	17.7	.71	8.8	73.5	11,830
3/64″	50 mesh	2,172	34.1	20.1	.80	9.6	70.3	11,410
50 mesh	100 mesh	815	12.8	24.5	.77	10.0	65.5	10,600
100 mesh	200 mesh	237	3.7	28.6	.71	10.6	60.8	9,750
200 mesh	------------	130	2.1	38.8	.78	12.3	48.9	8,110
Total		6,376	100.0	------------	------------	------------	------------	------------
Average		------------	------------	20.2	.73	9.3	70.5	11,708

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
------	5/16″	--------	--------	--------	--------	--------	--------	--------	--------
5/16″	3/16″	--------	--------	--------	--------	--------	--------	--------	--------
3/16″	3/32″	70.7	5.2	18.3	23.3	11.0	72.0	89.0	8.9
3/32″	3/64″	66.3	4.9	21.9	21.5	11.8	72.8	88.2	9.1
3/64″	50 mesh	--------	--------	--------	--------	--------	--------	--------	--------
50 mesh	100 mesh	--------	--------	--------	--------	--------	--------	--------	--------
100 mesh	200 mesh	--------	--------	--------	--------	--------	--------	--------	--------
200 mesh	----------	--------	--------	--------	--------	--------	--------	--------	--------
Total		--------	--------	--------	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	--------	--------	--------	--------

Analysis of current silt production, Spencer Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				per B. t. u. pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16″	292	8.5	35.9	1.69	68.3	.63	7.9	23.8	3,870
5/16″	3/16″	193	5.6	23.65	1.11	63.7	.89	7.9	28.5	4,540
3/16″	3/32″	207	6.0	25.3	1.19	43.7	1.05	7.7	48.6	7,780
3/32″	3/64″	275	8.0	33.7	1.59	27.6	.73	7.4	65.0	10,510
3/64″	50 mesh	1,118	32.6	137.2	6.46	25.4	.58	7.6	67.0	10,770
50 mesh	100 mesh	712	20.7	87.3	4.11	29.6	.70	7.3	63.1	10,130
100 mesh	200 mesh	275	8.0	33.7	1.80	35.3	.76	7.8	56.9	9,110
200 mesh	------------	362	10.6	44.4	2.10	42.9	.90	8.9	48.2	7,800
Total		3,434	100.0	421.1	20.00	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	36.0	.71	7.7	56.3	9,054

NAY AUG COAL MINING COMPANY

Nay Aug Colliery

This colliery was not in operation at the time of sampling. It normally ships 200 tons of coal per day. The silt discharged to the bank passes through 3/32-inch perforations. It is flushed out upon a small bank with built-up silt embankments through which the water escapes in sluiceways. This bank contains about 20,000 tons. An older and larger bank which contains 50,000 tons of silt has been opened up and partly loaded out by scraper line.

These banks contain very small percentages of oversize material. The new bank contains 1.1 per cent of No. 2 and No. 3 buckwheat and the old bank contains 1.7 per cent of these sizes, making an aggregate of only about 1100 tons of coal of commercial size in the silt banks on this property.

Analysis of old silt bank, Nay Aug Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16″	10	.1 }	28.2	.68	8.7	63.1	10,150
3/16″	3/32″	150	1.6 }					
3/32″	3/64″	1,760	18.4	28.6	.58	8.5	62.9	10,090
3/64″	50 mesh	5,400	56.5	31.5	.56	9.0	59.5	9,570
50 mesh	100 mesh	1,620	17.0	33.8	.63	9.5	56.7	9,140
100 mesh	200 mesh	460	4.8	36.9	.48	11.0	52.1	8,390
200 mesh	------------	154	1.6	41.7	.53	14.4	43.9	7,568
Total		9,554	100.0	--------	--------	--------	--------	--------
Average		--------	--------	31.7	.57	9.2	59.1	9,514

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	31.0	4.6	38.0	25.5	31.0	72.2	69.0	16.1
3/64"	50 mesh	49.3	5.8	22.3	22.0	28.4	74.0	71.6	10.8

Analysis of new northwest bank, Nay Aug Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	18	.3					
3/16"	3/32"	55	.8	30.1	.84	10.6	59.3	9,900
3/32"	3/64"	1,010	14.2	32.6	.67	7.7	59.7	9,550
3/64"	50 mesh	3,425	48.3	34.0	.64	7.9	58.1	9,350
50 mesh	100 mesh	1,800	25.4	40.2	.49	8.5	51.3	8,310
100 mesh	200 mesh	510	7.2	44.6	.57	9.8	45.6	7,630
200 mesh	----------	270	3.8	49.8	.91	11.4	38.8	6,370
Total		7,088	100.0	----------	----------	----------	----------	----------
Average		----------	----------	36.7	.61	8.3	55.0	8,884

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	53.5	6.9	13.1	30.7	33.4	74.0	66.6	11.6
3/64"	50 mesh	43.5	5.7	28.0	18.8	28.5	70.9	71.5	10.8

PENNSYLVANIA COAL COMPANY

Underwood Colliery

This plant prepares 3500 tons of coal per day over jigs and shaker screens. The screens through which the silt passes before being discharged from the breaker has 1/16-inch perforations. Silt is stocked in two large settling basins in the valley of a small stream. These basins are formed by rock embankments. Silt from the breaker is normally flumed to the first of these and the water from the first is discharged into the second to be further clarified. The run-off from this bank spreads out over an extensive wooded swamp in the valley below the settling basins, and a thin layer of very fine silt has been deposited in this swamp. It is impossible to measure or sample the water as it finally leaves the property but the facilities for settling the silt and clarifying the water are exceptionally good. No waste water flows away from the plant without passing through the silt basins. The silt accumulations in the two basins are approximately equal and aggregate 300,000 tons. The two basins were sampled separately by the surface sampling method, placing holes

on 100 foot centers. The material in the second or lower basin is smaller size and lower in ash content than that in the upper basin. These banks contain only about 2.2 per cent of commercial size coal (over 3/32 inch).

Analysis of upper silt bank, Underwood Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	21	.2	19.4	.70	7.8	72.8	11,930
5/16"	3/16"	51	.5	19.7	.60	6.7	73.6	11,900
3/16"	3/32"	198	1.9	19.4	.71	6.7	73.9	11,920
3/32"	3/64"	2,714	25.8	17.6	.70	6.9	75.5	12,250
3/64"	50 mesh	4,342	41.3	20.2	.70	6.0	73.8	11,760
50 mesh	100 mesh	2,064	19.6	27.1	1.50	7.2	65.7	10,750
100 mesh	200 mesh	636	6.0	36.6	1.30	6.8	56.6	9,122
200 mesh	------------	500	4.7	45.0	.70	7.6	47.4	7,600
Total		10,526	100.0	------------	------------	------------	------------	------------
Average		------------	------------	23.0	.89	6.6	70.4	11,338

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16"	3/32"	68.6	6.9	19.4	24.7	12.0	72.3	88.0	10.8
3/32"	3/64"	70.6	7.1	12.5	33.8	16.9	76.8	83.4	11.1

Analysis of lower silt bank, Underwood Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	18	.2					
5/16"	3/16"	25	.3	28.1	.60	6.8	65.1	10,490
3/16"	3/32"	105	1.3					
3/32"	3/64"	2,029	24.9	12.7	.70	6.2	81.1	13,040
3/64"	50 mesh	2,920	35.9	11.9	.70	6.6	81.5	13,110
50 mesh	100 mesh	1,724	21.3	16.9	.72	7.1	76.0	12,230
100 mesh	200 mesh	660	8.1	29.8	.69	6.4	63.8	10,160
200 mesh	------------	652	8.0	42.4	1.07	8.5	49.1	7,940
Total		8,130	100.0	------------	------------	------------	------------	------------
Average		------------	------------	17.3	.73	6.7	76.0	12,205

SCRANTON COAL COMPANY

Ontario Colliery

This plant prepares about 1000 to 1200 tons of coal per day over Simplex jigs and shaker screens. This is part fresh-mined and part bank coal. The silt is now being stocked on an extensive bank upon which the water is impounded by a silt embankment. After spread-

ing out over and traversing this bank the water runs off through several wooden sluices in the embankment and finally finds its way into a creek. This bank was started in 1923. The size of No. 3 buckwheat screen perforations, through which the silt passes, has been 3/32-inch during the life of the bank, but an auxiliary silt shaker with 3/32-inch perforations was installed about 3 months before the time of sampling. This auxiliary screen recovers accidental oversize coal in the silt before it is discharged to the bank. This undoubtedly made some change in the size of the silt which is being stocked. The screen analysis of an average sample of the bank showed it to contain 4.2 per cent of oversize, .6 per cent No. 1, .6 per cent No. 2, and 3.0 per cent of No. 3 buckwheat.

This is one of the two banks sampled intensively during the preliminary investigation, to establish a standard sampling procedure. The method of sampling is described in detail in that part of the report.

The rate of silt production is approximately 200 tons per day. This will probably vary with the proportion of bank coal to fresh-mined coal in the breaker feed.

The silt is flushed out upon the bank through a wooden flume carrying 600 gallons of water per minute. The water discharged from the bank could not be measured. A composite sample of the run-off water discharged at various points around the bank contained 1/10 of one pound of solids per gallon. This was very fine silt, 75 per cent through 50 mesh and contained 42.3 per cent ash.

In addition to the silt bank run-off water, this plant discharges approximately 500 gallons of waste water per minute from the loading pockets, cars and elevator-boot overflow. This water carries about 0.32 pounds of solids per gallon which amounts to 34 tons per day. This is practically all finer than No. 3 buckwheat. The quantity of commercial sizes lost in this water is half a ton per day.

Analysis of bank sample, Ontario Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	------------	.6	25.6	.84	7.4	67.0	10,880
5/16"	3/16"	------------	.5	26.5	1.04	7.6	65.9	10,720
5/16"	3/32"	------------	3.0	26.9	.92	9.4	63.7	10,520
3/32"	3/64"	------------	27.8	26.3	.78	7.4	66.3	10,780
3/64"	50 mesh	------------	42.4	27.7	.80	7.2	65.1	10,560
50 mesh	100 mesh	------------	17.6	33.9	.83	7.0	59.1	9,520
100 mesh	200 mesh	------------	4.9	42.6	1.01	7.5	49.9	7,971
200 mesh	------------	------------	3.2	51.0	1.57	8.4	40.6	6,520
Total		------------	100.0	------------	------------	------------	------------	------------
Average		------------	------------	29.8	.84	7.3	62.8	10,153

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16"	3/32"	61.2	8.4	19.4	35.3	19.4	72.7	80.6	16.6
3/32"	3/64"	63.5	8.3	17.3	38.3	19.1	73.1	80.8	14.7
3/64"	50 mesh	59.4	7.3	17.4	36.8	23.2	73.1	76.8	14.0
50 mesh	100 mesh	52.0	7.5	15.0	31.5	33.0	74.3	67.0	12.8
100 mesh	200 mesh	37.1	7.0	19.4	31.0	43.5	75.8	56.5	15.2
200 mesh	----------	3.2	8.3	48.4	40.1	48.4	59.8	51.6	38.1

Analysis of solids in silt bank run-off water, Ontario Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/32"	4	0.5	.5	--------	23.9	.88	9.0	67.1	11,070
3/32"	3/64"	73	8.6	8.9	--------					
3/64"	50 mesh	129	15.3	15.8	--------	24.2	.83	8.6	67.2	10,980
50 mesh	100 mesh	94	11.2	11.8	--------	35.4	.93	10.0	54.6	8,900
100 mesh	200 mesh	62	7.4	7.6	--------	35.9	.92	9.0	55.1	8,910
200 mesh	----------	480	57.0	58.8	--------	52.4	.99	10.6	37.0	6,000
Total		842	100.0	103.4	--------	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	42.3	.94	10.0	47.7	7,773

Analysis of solids in waste water from breaker, Ontario Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	11/16"	8	.3	.98	.10	--------	--------	--------	--------	--------
11/16"	9/16"	0	.0	--------	--------	--------	--------	--------	--------	--------
9/16"	5/16"	8	.3	.98	.10	--------	--------	--------	--------	--------
5/16"	3/16"	9	.3	1.10	.12	--------	--------	--------	--------	--------
3/16"	3/32"	19	.7	2.33	.25	--------	--------	--------	--------	--------
3/32"	3/64"	123	4.8	15.1	1.61	26.8	.74	6.8	66.4	10,700
3/64"	50 mesh	784	30.4	96.1	10.29	23.9	.90	7.7	68.4	11,040
50 mesh	100 mesh	600	23.4	73.6	7.89	25.7	.88	7.9	66.4	10,700
100 mesh	200 mesh	334	12.9	41.0	4.40	33.7	1.07	7.6	58.7	9,380
200 mesh	----------	694	26.9	85.1	9.12	52.2	1.13	9.6	38.2	6,240
Total		2,579	100.0	316.3	33.88	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	33.5	.97	8.2	58.3	94,128

HUMBERT COAL COMPANY

Sunnyside Colliery

This colliery produces about 450 tons of coal per day. It is prepared over jigs and shaker screens. The silt is flumed out upon a small bank and is retained by an embankment of silt which is kept built up around it. The water drains away through an iron pipe which is lengthened by short sections from time to time so as to keep its inlet slightly above the surface of the bank.

This run-off water, which carries some fine silt, flows into a small stream which is dammed to form a reservoir for the breaker water supply. Drip water from the loading and rock pockets also drains into this small reservoir. Except in periods of unusual rainfall there is practically no overflow from this reservoir but all the water is recirculated through the breaker. About twice a week, however, the basin is opened up and flushed out. The silt that has accumulated is washed down the stream.

The bank now being used for stocking current silt production was started in 1925 and at the time of sampling (June 21, 1926) contained about 15,000 tons. The size of screens during this period has been 1/16 inch. Screen analyses of samples of the bank showed it to contain about 1.5 per cent of No. 3 buckwheat (over 3/32-inch screen).

There is also an old bank containing about 50,000 tons of silt that was made through a 3/32-inch round-hole screen. This bank contains approximately 3500 tons of No. 3 buckwheat coal. Daily silt production is about 50 tons.

Analysis of new bank, Sunnyside Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	10	.1	30.0	.77	7.5	62.5	10,140
3/16"	3/32"	175	1.4					
3/32"	3/64"	2,210	17.9	31.2	1.0	7.7	61.1	9,960
3/64"	50 mesh	6,070	49.3	33.2	1.0	7.3	59.5	9,690
50 mesh	100 mesh	2,340	19.0	38.3	1.05	7.8	53.9	8,700
100 mesh	200 mesh	872	7.1	44.4	1.40	8.5	47.1	7,680
200 mesh	------------	640	5.2	53.3	1.20	9.9	36.8	6,090
Total		12,317	100.0	------------	------------	------------	------------	------------
Average		------------	------------	35.6	1.04	7.7	56.7	9,227

Analysis of solids in slush bank run-off water, Sunnyside Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	50 mesh	180	14.6	19.8	--------	32.1	.80	8.4	59.5	9,800
50 mesh	100 mesh	282	22.9	31.3	--------	36.7	.83	8.3	55.0	8,960
100 mesh	200 mesh	50	4.1	5.5	--------	25.4	.87	8.7	65.9	10,950
200 mesh	------------	720	58.4	79.5	--------	56.0	.69	9.2	34.8	5,660
Total		1,232	100.0	135.9	--------	--------	--------	--------	--------	--------
Average		--------	--------	--------	--------	46.9	.75	8.9	44.3	7,237

Analysis of old silt bank, Sunnyside Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	3/16"	72	.5	25.6	.7	9.2	65.2	10,580
3/16"	3/32"	932	6.4					
3/32"	3/64"	3,200	22.0	33.0	.61	9.5	57.5	9,420
3/64"	50 mesh	4,880	33.6	36.8	.54	10.3	52.9	8,780
50 mesh	100 mesh	2,640	18.2	41.1	.54	10.9	48.0	8,000
100 mesh	200 mesh	1,080	7.4	40.1	.60	11.5	48.4	8,190
200 mesh	------------	1,720	11.9	51.2	.40	12.7	36.1	6,320
Total		14,525	100.0	------------	------------	------------	------------	------------
Average		------------	------------	37.9	.56	10.6	51.5	8,566

Size		Specific gravity analysis							
		Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
Through	Over	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/32"	3/64"	25.4	5.9	10.4	29.1	14.2	74.0	85.8	8.7
3/64"	50 mesh	30.7	6.0	33.0	20.0	36.4	73.1	63.7	13.2

TEMPLE COAL COMPANY

Edgerton Colliery

The colliery is abandoned. The breaker has been destroyed and all that remained at the time of sampling was the railway sidings, heaps of slate and rock from the worked over culm bank, and two small silt banks aggregating about 70,000 tons.

Both banks are cut by ravines and old workings. The east bank, near the railway, had been worked recently by steam shovel and a long fresh face was exposed. These openings greatly facilitated sampling. The two banks were sampled with the 4-foot tube, by the surface-sampling method, supplemented by channel samples on the exposed sections.

These two silt banks are very similar in character. Each contains very small percentages of No. 1 and No. 2 buckwheat and about 20 per cent of No. 3 buckwheat. The ash content is unusually low. The aggregate tonnage of commercial sizes is about 300 of No. 1 buckwheat, 700 of No. 2 and 14,000 tons of No. 3.

Analysis of west bank, Edgerton Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16″	57	.5					
5/16″	3/16″	15	.1	12.6	.66	10.0	77.4	12,560
3/16″	3/32″	1,830	17.9					
3/32″	3/64″	3,372	33.1	10.7	.63	8.6	80.7	12,990
3/64″	50 mesh	2,990	29.3	11.5	.70	8.8	79.7	12,720
50 mesh	100 mesh	1,210	11.9	15.0	.72	10.5	74.5	12,080
100 mesh	200 mesh	344	3.4	20.4	.94	11.1	68.5	11,070
200 mesh	------------	384	3.8	30.5	.95	11.6	57.9	9,350
Total		10,202	100.0	------------	------------	------------	------------	------------
Average		------------	------------	12.9	.68	9.3	77.8	12,519

Analysis of east bank, Edgerton Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16″	53	.3	16.9	.76	7.4	75.7	12,140
5/16″	3/16″	183	1.8					
3/16″	3/32″	1,970	20.0	15.4	.82	7.7	76.9	12,390
3/32″	3/64″	2,718	27.5	16.2	.82	8.6	75.2	12,200
3/64″	50 mesh	2,960	30.0	18.6	.90	9.2	72.2	11,760
50 mesh	200 mesh	1,654	16.8	25.2	.94	10.9	63.9	10,530
200 mesh	------------	330	3.4	35.0	12.0	13.7	51.3	8,600
Total		9,868	100.0	------------	------------	------------	------------	------------
Average		------------	------------	18.9	.97	9.1	72.0	11,674

Size		Specific gravity analysis							
Through	Over	Lighter than 1.6		1.6 to 1.9		Heavier than 1.9		Combined float on 1.9	
		Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash	Per cent of total	Ash
3/16″	3/32″	77.8	5.5	13.1	28.4	9.1	72.9	90.9	8.8

HILLSIDE COAL & IRON COMPANY

Forest City Colliery

This colliery ships about 1400 tons of coal per day. It is prepared by Simplex and Menzies jigs and Parrish shaker screens. The silt is flumed out upon an extensive bank which covers a swamp and an old river channel along Lackawanna River. This bank is roughly 2800 feet long by 520 feet wide and has a maximum thickness of 30 feet. It is partially surrounded by an embankment of rock and washery refuse. About 1500 gallons of water per minute is flumed out upon the bank with the silt. The greater part of this

water sinks into the ground or filters out through the embankment.

This bank has been accumulating since 1908. Barley coal, the smallest size which is prepared, has been made over 3/32-inch round-hole screens throughout the life of the bank.

At the time of sampling, the silt delivered to the bank was completely settled and retained; the jig slush water and dripping from loading pockets and cars carries some fine coal into the river.

The bank was sampled by the surface sampling method. Lines of sample holes were spaced 100 paces apart across the bank. The waste water discharged to the river was sampled at half hour intervals throughout a day's operation and the rate of flow was measured by a 16-inch, sharp-crest wier.

Screen analysis of the bank sample showed that it contains only 2 per cent oversize (No. 3 buckwheat or barley coal over 3/32-inch screen) and 19.6 per cent of No. 4 buckwheat. Based on an estimated 100,000 tons from this colliery, there are approximately 2,000 tons of No. 3 and 20,000 tons of No. 4 buckwheat coal of 19.3 per cent ash and 14.0 per cent ash respectively available in the bank. The waste water from the jigs and loading plant carries 8½ tons of solids into the river daily. This is approximately 0.4 per cent of the tonnage handled through the plant. Approximately 20 per cent of this loss, or 1½ tons is of commercial size (over 3/32-inch) and averages 18.0 per cent in ash.

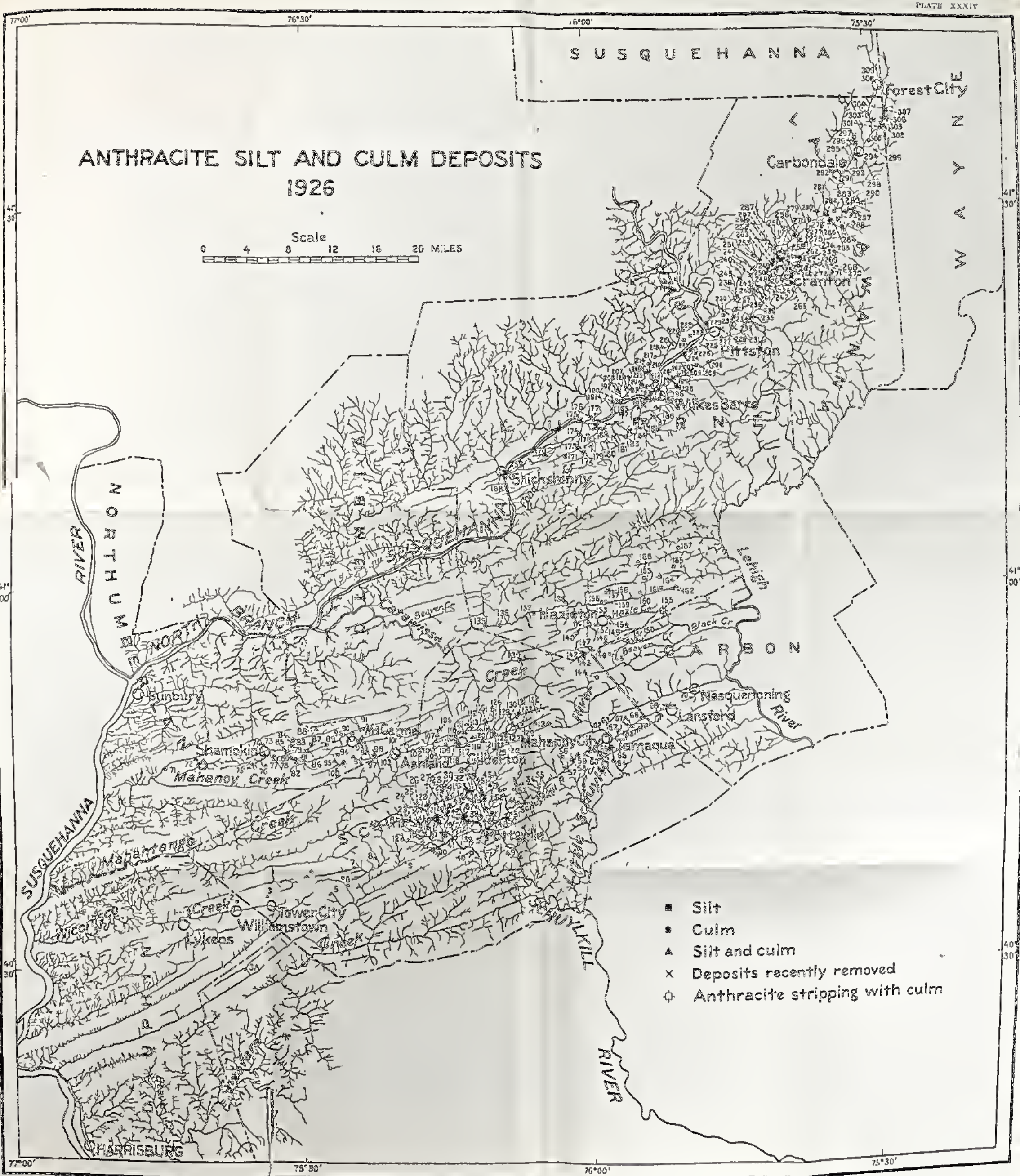
Analysis of solids in waste water from breaker, Forest City Colliery.

Size		Screen analysis		Quantity of solids		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Pounds per 1,000 gal.	Tons per 8 hr. day	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	32	4.6	3.5	.39	19.3	1.18	7.7	73.0	12,070
5/16"	3/16"	20	2.9	2.2	.24	14.0	1.34	10.4	75.6	13,110
3/16"	3/32"	80	11.7	8.9	.99	18.6	1.20	7.1	74.3	12,250
3/32"	3/64"	100	14.5	11.0	1.22	19.1	1.07	7.8	73.1	12,140
3/64"	50 mesh	165	23.9	18.2	2.02	29.0	.90	7.1	63.9	10,540
50 mesh	100 mesh	90	13.1	9.9	1.10	27.4	1.01	7.6	65.0	10,780
100 mesh	200 mesh	47	6.8	5.2	.58	28.6	.95	7.5	63.9	10,560
200 mesh	------------	155	22.5	17.1	1.90	50.6	.74	7.8	41.6	6,860
Total		689	100.0	76.0	8.44	-------	-------	-------	-------	----------
Average		-------	-------	----------	-------	30.1	.96	7.6	62.3	10,322

Analysis of bank sample, Forest City Colliery.

Size		Screen analysis		Chemical analysis				B. t. u. per pound
Through	Over	Grams	Per cent of total	Ash	Sulphur	Volatile matter	Fixed carbon	
------	5/16"	*	----------	----------	----------	----------	----------	----------
------	3/16"	24	.3	23.3	.62	12.0	64.7	11,350
3/16"	3/32"	147	1.7	28.0	.93	7.9	64.1	10,630
3/32"	3/64"	1,705	19.6	26.4	1.06	7.7	65.9	10,830
3/64"	50 mesh	3,690	42.5	28.6	1.23	7.6	63.8	10,470
50 mesh	100 mesh	1,710	19.7	34.3	1.64	7.0	58.7	9,600
100 mesh	200 mesh	725	8.3	34.7	1.46	7.3	58.0	8,960
200 mesh	------------	690	7.9	46.4	.85	7.7	45.9	7,510
Total		8,691	100.0	----------	----------	----------	----------	----------
Average		----------	----------	31.2	1.26	7.5	61.3	10,015

*2 pieces.


ANTHRACITE SILT AND CULM DEPOSITS
1926
Scale
0 4 8 12 16 20 MILES
77°00'
76°30'
76°00'
75°30'
41°30'
41°00'
40°30'
SUSQUEHANNA
WAYNE
LACKAWANNA
LUZERNE
COLUMBIA
NORTHUMBERLAND
CARBON
SCHUYLKILL
DAUPHIN
Forest City
Carbondale
Scranton
Pittston
Wilkes Barre
Shickshinny
Hazleton
Nesquehoning
Lansford
Tamaqua
Mahanoy City
Gilberton
Ashland
Shamokin
Sunbury
Pottsville
Williamstown
Tower City
Lykens
Harrisburg
SUSQUEHANNA
RIVER
NORTH BRANCH
Lehigh
River
Black Cr.
Mahanoy Creek
SCHUYLKILL
RIVER
Silt
Culm
Silt and culm
Deposits recently removed
Anthracite stripping with culm

SUMMARY OF CULM AND SILT RESOURCES IN PENNSYLVANIA ANTHRACITE FIELDS BY COLLIERIES AND FIELDS

[Map numbers correspond to numbers in text. (ab)=abandoned. Quantity in long tons.]

SOUTHERN FIELD.

Map No.	Company	Colliery	Culm	Silt	Mixed
1	Susquehanna Collieries	Short Mountain	100,000	1,500,000	
2	Susquehanna Collieries	Williamstown		750,000	
3	Philadelphia & Reading Coal & Iron	Brookside			3,500,000
3A	Philadelphia & Reading Coal & Iron	Rausch Gap (ab)	300,000		
4	Philadelphia & Reading Coal & Iron	Good Spring			3,000,000
5	Philadelphia & Reading Coal & Iron	Lincoln			4,500,000
6	Philadelphia & Reading Coal & Iron	East Franklin and Lower Rausch Creek (ab)		500,000	
7	Philadelphia & Reading Coal & Iron	Colbert	150,000		
8	Philadelphia & Reading Coal & Iron	Middle Creek		500,000	
9	Lehigh Valley Coal	Blackwood			500,000
10	Philadelphia & Reading Coal & Iron	Old Silverton	300,000	400,000	
11	Philadelphia & Reading Coal & Iron		100,000		
12	Philadelphia & Reading Coal & Iron	Otto	1,000,000		
13	Philadelphia & Reading Coal & Iron	Phoenix Park	1,300,000	5,000,000	
14	Susquehanna Collieries	Lytle		1,000,000	
15	Susquehanna Collieries	Lytle Washery		300,000	
16	Pine Hill Coal	Pine Hill		3,000,000	
17	Wolf Creek Coal	Wolf Creek Washery	150,000	300,000	
18	Philadelphia & Reading Coal & Iron		200,000		
19	Pine Hill Coal	Oak Hill	4,000,000	100,000	
20	Philadelphia & Reading Coal & Iron		400,000		
21	Philadelphia & Reading Coal & Iron		50,000		
22	Black Heath Coal			75,000	
23	Philadelphia & Reading Coal & Iron	Buck Run		2,500,000	
24	Philadelphia & Reading Coal & Iron	Glen Dower (ab)	3,100,000	300,000	
25	Philadelphia & Reading Coal & Iron	Richardson	3,000,000	500,000	
26	Philadelphia & Reading Coal & Iron		50,000		
27	Philadelphia & Reading Coal & Iron	Thomaston (ab)	1,540,000	1,300,000	
28	Philadelphia & Reading Coal & Iron	Anchor Washery	300,000	300,000	
29	Pine Hill Coal	East Ridge (ab)		200,000	
30	Philadelphia & Reading Coal & Iron	Pine Knot	300,000	700,000	
31	Philadelphia & Reading Coal & Iron		100,000		
32	Philadelphia & Reading Coal & Iron		300,000		
33	Keppler Coal		10,000	300,000	
34	Beecher Creek Coal	Laurel Run		50,000	
35	Keppler Coal	New Castle		50,000	
36	Philadelphia & Reading Coal & Iron	Wadesville		100,000	
37	Philadelphia & Reading Coal & Iron		800,000		
38	Philadelphia & Reading Coal & Iron		300,000		
39	Philadelphia & Reading Coal & Iron		400,000		
40	Hudson Coal	Chamberlain bank	50,000		
41	Philadelphia & Reading Coal & Iron	Thomson bank	50,000		
42	Philadelphia & Reading Coal & Iron		500,000		
43	Philadelphia & Reading Coal & Iron		1,000,000		
44	Philadelphia & Reading Coal & Iron		2,000,000		
45	Philadelphia & Reading Coal & Iron		250,000		
46	Alliance Coal	Old Palmer		500,000	
47	Mt. Clair Coal	St. Clair		1,000,000	
47A			75,000		
48	Philadelphia & Reading Coal & Iron		400,000		
49	Philadelphia & Reading Coal & Iron	Pine Forest	1,000,000	400,000	
50	Philadelphia & Reading Coal & Iron		75,000		
51	Philadelphia & Reading Coal & Iron		75,000		
52	South Penn Collieries	Randolph	900,000		
53	Franklin Coal	[illegible]		50,000	
54	Philadelphia & Reading Coal & Iron	Eagle Hill	3,000,000	10,000,000	
55	Philadelphia & Reading Coal & Iron	Silver Creek		1,500,000	1,000,000
56	Lehigh Coal & Navigation	Alliance	100,000	600,000	
57	Owner unknown		75,000		
58	Hazelbrook Coal	Mary D		75,000	
59	German & Campion Coal	Bell		150,000	300,000
60	Philadelphia & Reading Coal & Iron				
61	Philadelphia & Reading Coal & Iron	Boston Run (ab)	1,000,000		
62	Philadelphia & Reading Coal & Iron	Brookdale	800,000		
63	Philadelphia & Reading Coal & Iron	Newkirk (ab)	3,100,000	800,000	
64	Philadelphia & Reading Coal & Iron		600,000		
65	Lehigh Coal & Navigation		50,000		
66	Arnage Washery		500,000		
67	Philadelphia & Reading Coal & Iron		500,000		
67A	East Lehigh Coal	East Lehigh (ab)	200,000		
68	Lehigh Coal & Navigation	Tamaqua	500,000	400,000	
69	Lehigh Coal & Navigation	Greenwood		600,000	
70	Lehigh Coal & Navigation	Coaldale No. [illegible]	300,000	800,000	
	Lehigh Coal & Navigation	Lansford	500,000	300,000	
	Lehigh Coal & Navigation	Nesquehoning	300,000	1,000,000	
	Total		37,970,000	37,415,000	12,700,000
	Grand total of Southern Field		88,085,000		

WESTERN MIDDLE FIELD.

Map No.	Company	Colliery	Culm	Silt	Mixed
71	South Penn Collieries	Kathryn		40,000	
72	Philadelphia & Reading Coal & Iron	North Franklin	1,000,000	1,500,000	
73	Susquehanna Collieries	Cameron	50,000		
74	Shamokin Coal	Shamokin			175,000
75	Philadelphia & Reading Coal & Iron	Bear Valley	500,000	112,000	
76	Philadelphia & Reading Coal & Iron	Burnside	500,000	750,000	
77	Philadelphia & Reading Coal & Iron	Henry Clay	1,000,000	750,000	
78	Philadelphia & Reading Coal & Iron	Henry Clay	100,000		
79	Puritan Coal	Buck Ridge		75,000	
80	Philadelphia & Reading Coal & Iron	Old Greenback	500,000		
81	Excelsior Coal	Carbon	1,000,000		
82	Northumberland Mining	Enterprise	800,000	800,000	
83	Shipman Coal	Glenburn		10,000	
84	Susquehanna Collieries	Washery	50,000		
85	Susquehanna Collieries	Luke Fidler		800,000	
86	Susquehanna Collieries	Scott		1,000,000	
87	Colonial Colliery	Greenough		2,000,000	
88	Colonial Colliery	Natalie	600,000	500,000	
89	Susquehanna Collieries	Pennsylvania		1,000,000	
90	Susquehanna Collieries	Richards		200,000	
91	Weston	Midvalley		3,000,000	
92	Lehigh Valley Coal	Sayre	1,000,000	1,000,000	
93	Philadelphia & Reading Coal & Iron	Reliance	1,750,000	1,000,000	
94	Philadelphia & Reading Coal & Iron	Alaska		500,000	
95	Philadelphia & Reading Coal & Iron	Locust Gap		750,000	
96	Lehigh Valley Coal	[illegible] (ab)	2,500,000	2,500,000	
97	Philadelphia & Reading Coal & Iron	Keystone (ab)	2,500,000		
98	Philadelphia & Reading Coal & Iron	Potts	1,000,000		
99	Philadelphia & Reading Coal & Iron	Merriam (ab)	2,000,000	2,000,000	
100	Philadelphia & Reading Coal & Iron	Old Johns (ab)	1,000,000	500,000	
101	Philadelphia & Reading Coal & Iron	Centralia	1,000,000		
102	Lehigh Valley Coal	Bast	1,000,000	2,000,000	
103	Philadelphia & Reading Coal & Iron	[illegible] Tunnel (ab)	1,000,000	1,250,000	
104	Philadelphia & Reading Coal & Iron	Preston No. 3 (ab)	1,000,000	1,000,000	
105	Philadelphia & Reading Coal & Iron	Girard	400,000	1,000,000	
106	Weston	Girard Mammoth	300,000	600,000	
107	Philadelphia & Reading Coal & Iron	Hammond	300,000	2,000,000	
108	Lehigh Valley Coal	Packer No. 5	1,500,000	2,000,000	
109	Philadelphia & Reading Coal & Iron	West Bear Ridge (ab)		2,000,000	
110	Lehigh Valley Coal	Packer Nos. 2, 3, and 4		1,200,000	
111	Susquehanna Collieries	William Penn	2,000,000	5,000,000	
112	Locust Coal	Locust Mountain	500,000	400,000	
113	Philadelphia & Reading Coal & Iron	West Shenandoah	500,000	400,000	
114	Philadelphia & Reading Coal & Iron	Shenandoah City	300,000	300,000	
115	Harleigh-Brookwood	Kehley Run			600,000
116	Philadelphia & Reading Coal & Iron	Indian Ridge (ab)	2,000,000	50,000	
117	Harleigh-Brookwood	Lawrence	2,000,000	1,000,000	
118	Philadelphia & Reading Coal & Iron	Stanton			2,000,000
119	Philadelphia & Reading Coal & Iron	Draper (ab)		500,000	
120	Philadelphia & Reading Coal & Iron	Gilberton			3,000,000
121	Philadelphia & Reading Coal & Iron	Boston Run (ab)	30,000	500,000	
122	Philadelphia & Reading Coal & Iron	St. Nicholas		500,000	
123	Philadelphia & Reading Coal & Iron	Maple Hill			5,000,000
124	Madeira Hill Coal	Ellangowan			1,000,000
125	Madeira Hill Coal	Morea	400,000		
126	Philadelphia & Reading Coal & Iron	New Boston	400,000	100,000	
127	Philadelphia & Reading Coal & Iron	Tunnel Ridge	1,300,000	100,000	
128	Lehigh Valley Coal	Mahanoy City and North Mahanoy	1,700,000	600,000	
129	Lehigh Valley Coal	Glendon (ab)	500,000		
130	Lehigh Valley Coal	Springdale Washery	1,000,000		
131	Lehigh Valley Coal	Old Springdale Washery (ab)	300,000		
132	Lehigh Valley Coal	Park	50,000	300,000	
133	Lehigh Valley Coal	Park [illegible] (ab)	1,500,000		
134	Lehigh Valley Coal	Buck Mountain	1,000,000	50,000	
	Total		42,585,000	41,935,000	17,175,000
	Grand total of Western Middle Field		101,695,000		

EASTERN MIDDLE FIELD.

Map No.	Company	Colliery	Culm	Silt	Mixed
135	Buck Mountain Coal	Buck Mountain	25,000		
136	Coxe Brothers		100,000		
137	Coxe Brothers		150,000		
138	Hazle Mountain Coal	Black Ridge (ab)	100,000	100,000	
139	Coxe Brothers	Oneida (ab)		500,000	
140	Harwood Coal	Harwood		300,000	
141	Cranberry Creek	Cranberry	100,000	500,000	
142	Lehigh & Wilkes-Barre	Honey Brook			400,000
143	Lehigh & Wilkes-Barre	Audenried	100,000		300,000
144	Crookdale Collieries	Capitalem	100,000		
145	Lehigh & Wilkes-Barre	Tresckow	15,000		
146	Lehigh Valley Coal	Spring Brook	100,000		
147	Hudson Coal	Beaver Brook	300,000	300,000	
148	Lehigh Valley Coal	Spring Mountain			375,000
149	Coleraine Coal	Washery	300,000		
150	Evans Colliery	Evans			10,000
151	Coxe Brothers	Beaver Meadow		15,000	
152	Lehigh Valley Coal	Hazleton No. 1		35,000	400,000
153	Lehigh Valley Coal	Hazleton shaft	175,000	250,000	
154	Owner unknown			250,000	
155	Hazle Brook Coal	Hazle Brook		100,000	
156	Pardee Brothers	Lattimer		500,000	
157	Pardee Brothers	Lattimer No. 2		100,000	
158	Harleigh Coal	Washery	100,000		
159	Jeddo Highland Coal	Harleigh		300,000	
160	Jeddo Highland Coal	Jeddo No. 4		600,000	
161	Jeddo Highland Coal	Highland No. 5		400,000	
162	Coxe Brothers	Ebervale		500,000	
163	Coxe Brothers	Drifton		200,000	
164	Jeddo Highland Coal	Highland No. 2		40,000	
165	M. S. Kemmerer	Sandy Run		200,000	
166	Hazle Brook Coal	Upper Lehigh	500,000	150,000	
167	East Point Coal		5,000		
	Total		2,430,000	6,200,000	1,385,000
	Grand total of Eastern Middle Field		10,015,000		

NORTHERN FIELD.

Map No.	Company	Colliery	Culm	Silt	Mixed
168	Stackhouse Coal	Salem		300,000	
169	West End Coal	Mocanaqua			75,000
170	Susquehanna Collieries	No. 6	100,000	50,000	
171	Lehigh & Wilkes-Barre Coal	Wanamie	250,000		
172	East Alden Mining	East Alden		15,000	
173	Alden Coal	Alden	50,000	150,000	
174	Susquehanna Collieries	No. 7	50,000	25,000	
175	Grand Tunnel Coal	West Nanticoke		60,000	
176	George F. Lee	Chauncey	50,000	40,000	
177	Glen Alden Coal	Avondale		200,000	
178	Glen Alden Coal	Auchincloss	300,000	250,000	
179	Glen Alden Coal	Bliss	100,000	250,000	
180	Glen Alden Coal	Truesdale	600,000	200,000	
181	Lehigh Valley Coal	Warrior Run			
182	Glen Alden Coal	Loomis	300,000	900,000	
183	Pittston Coal Mining	Hadley		250,000	
184	Lehigh & Wilkes-Barre Coal	Sugar Notch			
185	Lehigh & Wilkes-Barre Coal	Buttonwood		200,000	
186	Lehigh & Wilkes-Barre Coal	Maxwell			
187	Lehigh Valley Coal	Franklin			
188	Lehigh & Wilkes-Barre Coal	Stanton			150,000
189	Lehigh & Wilkes-Barre Coal	South Wilkes Barre			
190	Plymouth Red Ash Coal Co.				
191	Lehigh & Wilkes-Barre	Nottingham	5,000		
192	Plymouth Coal	(ab)	10,000	5,000	
193	Lehigh & Wilkes-Barre Coal	Lance			1,000,000
194	Lehigh & Wilkes-Barre Coal	Hollenback	100,000		
195	Sullivan & Flinn Coal		50,000		
196	Hudson Coal	Baltimore No. 5	300,000	150,000	
197	Lehigh Valley Coal	Dorrance			
198	Lehigh Valley Coal	Mineral Springs	300,000		
199	Hudson Coal	Pine Ridge	150,000		
200	Lehigh Valley Coal	Prospect			400,000
201	Lehigh Valley Coal	Henry Clay			
202	Cannon Coal				
203	Central Coal	Wyoming			
204	Colonial Colliery	Madeira			
205	Hudson Coal	Laflin		200,000	
206	Traders Coal	Edgewood	200,000	30,000	
207	Hudson Coal	Loree No. 2	60,000		
208	Kingston Coal	Gaylord	10,000		
209	Kingston Coal	Kingston No. 2			
210	Glen Alden	Woodward	50,000		
211	Kingston Coal	Kingston No. 4	100,000		
212	Glen Alden	Pettebone		60,000	
213	East Boston Coal	East Boston	700,000		
214	Haddock Mining	Black Diamond			
215	Raub Coal				
216	Temple Coal	Harry E		250,000	
217	Temple Coal	Forty Fort		200,000	
218	Lehigh Valley Coal	Maltby	50,000	200,000	
219	Lehigh Valley Coal	Westmoreland			
220	Healey Coal	Troy	100,000		
221	Temple Coal	Mt. Lookout		300,000	
222	Harris Denny	Alnie		50,000	
223	Lehigh Valley Coal	Exeter		300,000	
224	Pennsylvania Coal	No. 14		150,000	
225	Pennsylvania Coal	Inkerman No. 6		300,000	
226	Pennsylvania Coal	Ewen			
227	Pennsylvania Coal	Butler	100,000	400,000	
228	Pennsylvania Coal	No. 9			
229	Lehigh Valley	Seneca		300,000	
230	Glen Alden	Halstead	200,000		
231	Suffolk Anthracite Collieries	Avoca			
232	Lehigh Valley Coal	Heidelberg		250,000	
233	T. F. Quinn Coal	Consolidated		300,000	
234	Pennsylvania Coal	Central			
235	Powell-Jennings Coal	[illegible] Glen			
236	Pennsylvania Coal	Old Forge			
237	Jermyn & Company	Jermyn			
238	Pennington	Washery	100,000		
239	Scranton Anthracite Coal	Oak Hill			
240	Glen Alden Coal	Taylor			
241	Hudson Coal	Greenwood			
242	W. J. Moffat Coal				
243	Black Diamond	Washery	50,000	70,000	
244	John Gibbons Coal	Gibbons			
245	Glen Alden Coal	Pine			
246	Glen Alden Coal	Archbald		800,000	
247	Glen Alden Coal	Continental			
248	Glen Alden Coal	Baker		200,000	
249	Peoples Coal	Oxford			
250	Glen Alden	Hyde Park			
251	Scranton Coal	Capouse			70,000
252	Glen Alden Coal	Diamond		500,000	
253	Lackawanna Fuel	Ransome			
254	Mid City Coal				
255	South Penn Collieries	Von Storch	25,000		
256	Providence Coal Co.				
257	Scranton Coal	West Ridge			
258	Leggitts Creek Anthracite	Leggett Creek			
259	Hudson Coal	Marvine			
260	Scranton Coal	Richmond No. 3			
261	Hudson Coal	Manville			
262	Green Ridge Coal	Greenridge			
263	Scranton Coal	Mt. Pleasant	50,000		
264	Scranton Coal	Pine Brook	25,000		
265	Roaring Brook Coal	Roaring Brook			
266	Reichter Coal	Reichter Slope			
267	Pennsylvania Coal	Pennsylvania No. 6			
268	Carney and Brown				
269	Pennsylvania Coal	Pennsylvania No. 1		250,000	
270	Meadowside Coal				
271	Spencer Coal		100,000	150,000	
272	Nay Aug Coal	Nay Aug		100,000	
273	Pennsylvania Coal	Underwood		300,000	
274	Pyne-Panoset	Panoset			
275	Glen Alden Coal	Storrs		100,000	
276	Scranton Coal	Johnson			
277	Hudson Coal	Eddy Creek	300,000		
278	Hudson Coal	Olyphant			
279	Lackawanna Coal	Lackawanna	450,000		

NORTHERN FIELD—Continued.

Map No.	Company	Colliery	Culm	Silt	Mixed
280	Scranton Coal	Ontario	300,000	150,000	
281	Scranton Coal	Raymond			
282	Radiant Coal	Rhoddie	200,000	150,000	
283	Scranton Coal	Riverside		30,000	
284	Humbert Coal	Sunnyside	50,000		
285	Temple Coal	Sterrick Creek	[illegible]		
286	Mt. Jessup Coal	Mt. Jessup			
287	Winton Coal	Winton	200,000		
288	Suffolk Anthracite Collieries	Rose Washery	150,000		
289	Hudson Coal	Gravity Slope	175,000	150,000	
290	Suffolk Anthracite Collieries	Tappan			
291	Hudson Coal	Jermyn	200,000	200,000	
292	Ammerman Coal	Fireside			
293	Hillside Coal & Iron	Erie			
294	Hudson Coal	Powderly No. 4	200,000		
295	Sunrise Coal				
296	Fallbrook Coal	Fallbrook			
297	Lackawanna Coal Corp.	Falls			
298	Suffolk Anthracite Collieries	Roland			
299	Racket Brook Coal	Racket Brook			
300	Hudson Coal	Coalbrook	125,000		
301	Murray Coal	Murray B			
302	Suffolk Anthracite Collieries	Nay Aug No. 4			
303	Wilson Hill Coal	Franklin			
304	Richmondale Coal	Richmondale			
305	Temple Coal	Northwest			
306	Red Haven Coal	East Side			
307	Hudson Coal	Clinton		100,000	
308	Pennsylvania Coal	Forest City		100,000	
309	Clifford Coal	Clifford			
	Total		7,965,000	8,195,000	1,795,000
	Grand total of Northern Field		17,955,000		

Culm and silt stored in banks in the Anthracite Region, in long tons*

Field	Culm	Silt	Mixed	Total
Southern	37,970,000	37,415,000	12,700,000	88,085,000
Western Middle	42,585,000	41,935,000	17,175,000	101,695,000
Eastern Middle	2,430,000	6,200,000	1,385,000	10,015,000
Northern	7,965,000	8,195,000	1,795,000	17,955,000
Total for all fields	90,950,000	93,745,000	33,055,000	217,750,000

*These tonnages are not recoverable marketable coal. The material composing these banks ranges from 30 to 80 per cent combustible material.

These figures are corrections of those on page 21.

RCES

NORTHERN FIELD—Continued.

Company	Colliery	Culm	Silt	Mixed
al	Ontario	200,000	150,000	
al	Raymond			
l	Rhondda	200,000	150,000	
al	Riverside		30,000	
al	Sunnyside	50,000		
l	Sterrick Creek	on fire		
Coal	Mt. Jessup			
l	Winton	200,000		
racite Collieries	Rose Washery	150,000		
l	Gravity Slope	175,000	150,000	
racite Collieries	Tappan			
l	Jermyn	200,000	200,000	
Coal	Fireside			
& Iron	Erie			
l	Powderly No. 2	200,000		
l				
oal	Fallbrook			
Coal Corp.	Falls			
racite Collieries	Boland			
k Coal	Racket Brook			
l	Coalbrook	225,000		
l	Murray B			
racite Collieries	Nay Aug No. 2			
Coal	Franklin			
Coal	Richmondale			
l	Northwest			
Coal	East Side			
l	Clinton		100,000	
Coal	Forest City		100,000	
l	Clifford			
		7,965,000	8,195,000	1,795,000
total of Northern Field		17,955,000		

silt stored in banks in the Anthracite Region, in long tons*

eld	Culm	Silt	Mixed	Total
....	37,970,000	37,415,000	12,700,000	88,085,000
iddle ..	42,585,000	41,935,000	17,175,000	101,695,000
iddle ..	2,430,000	6,200,000	1,385,000	10,015,000
....	7,965,000	8,195,000	1,795,000	17,955,000

INDEX

This index is arranged under the following heads: General, Coal Companies, Collieries, Places, Streams.

GENERAL

COAL COMPANIES

COLLIERIES

PLACES

STREAMS